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Tanaka et al.

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(54) **COLUMN STRUCTURE AND BASE MEMBER**

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E04B 1/24	(2006.01)

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CPC ... ***E04C 3/32*** (2013.01); ***E04B 1/24*** (2013.01); *E04B 1/4157* (2013.01); *E04B 2001/2463* (2013.01)

(58) **Field of Classification Search**

CPC E04C 3/32; E04C 2/08; E04B 1/4157; E04B 2103/06

See application file for complete search history.

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(57) **ABSTRACT**

In a column structure, a steel column serving as a column member is joined to a base plate serving as a base member. The steel column is configured by a pair of flanges provided at each of two width direction ends of a web. One end side of the base plate is fixed by first anchor members. The other end side of the base plate is fixed by second anchor members, and the second anchor members are formed with higher tensile strength than the first anchor members.

15 Claims, 11 Drawing Sheets

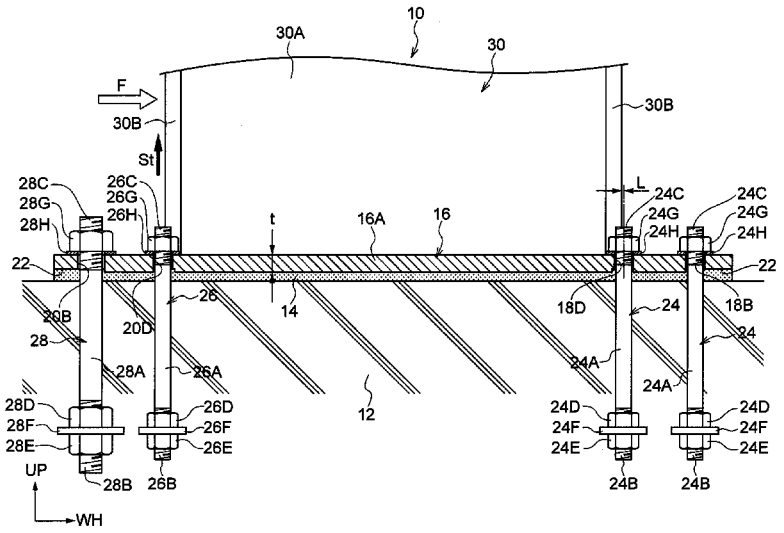

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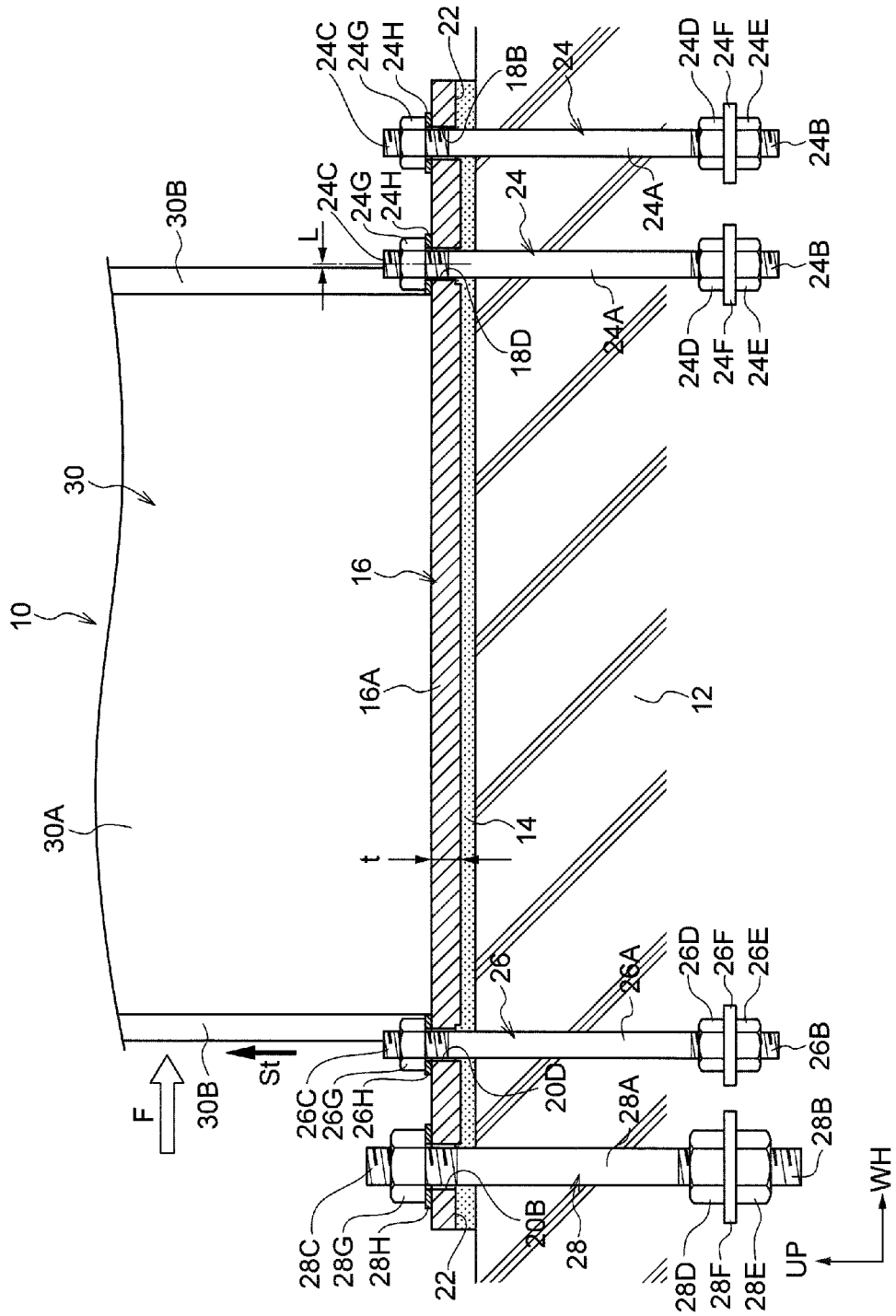
FIG.1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26H
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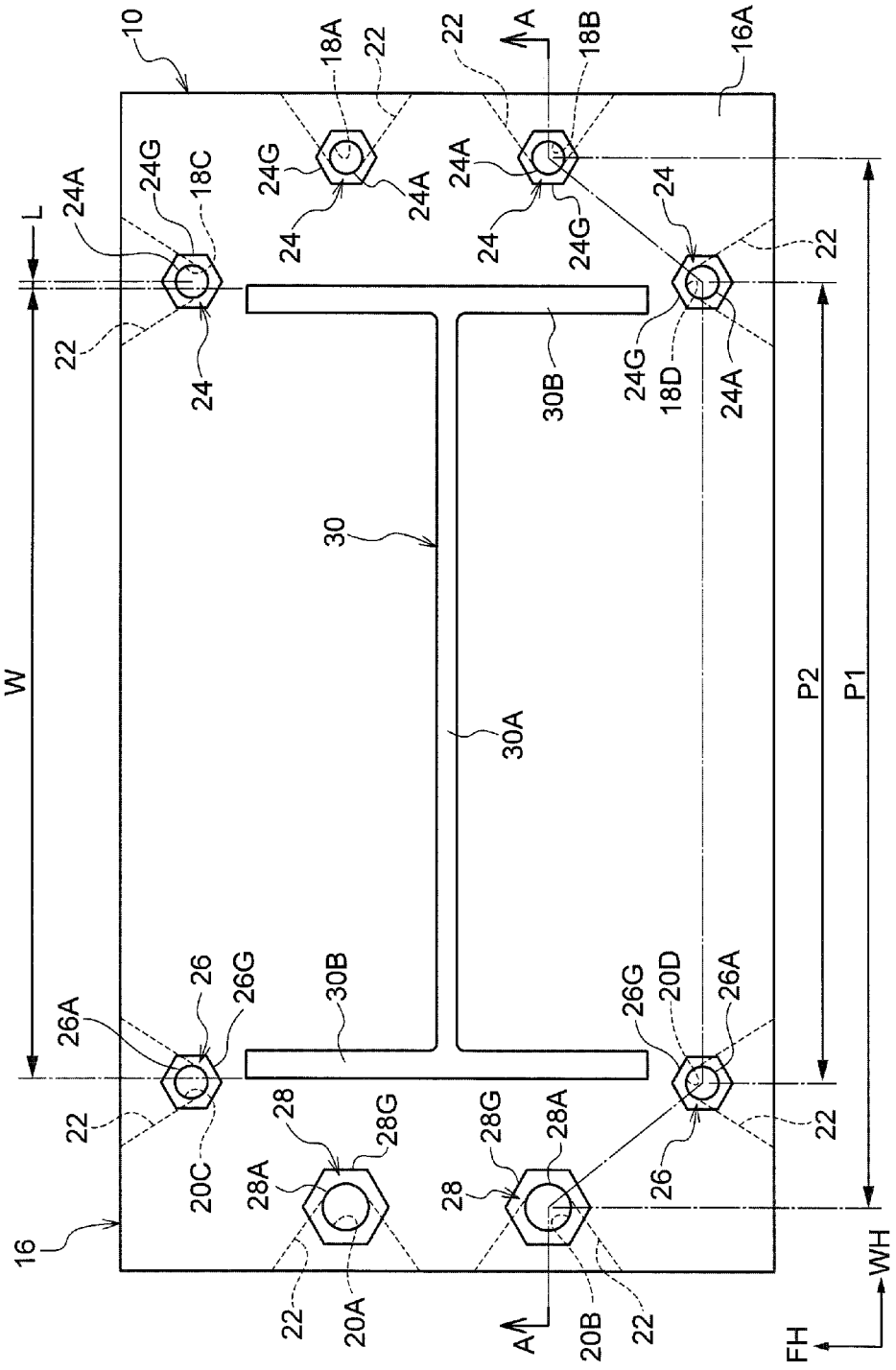
FIG.2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30B
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20D
26A
22
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FIG.3

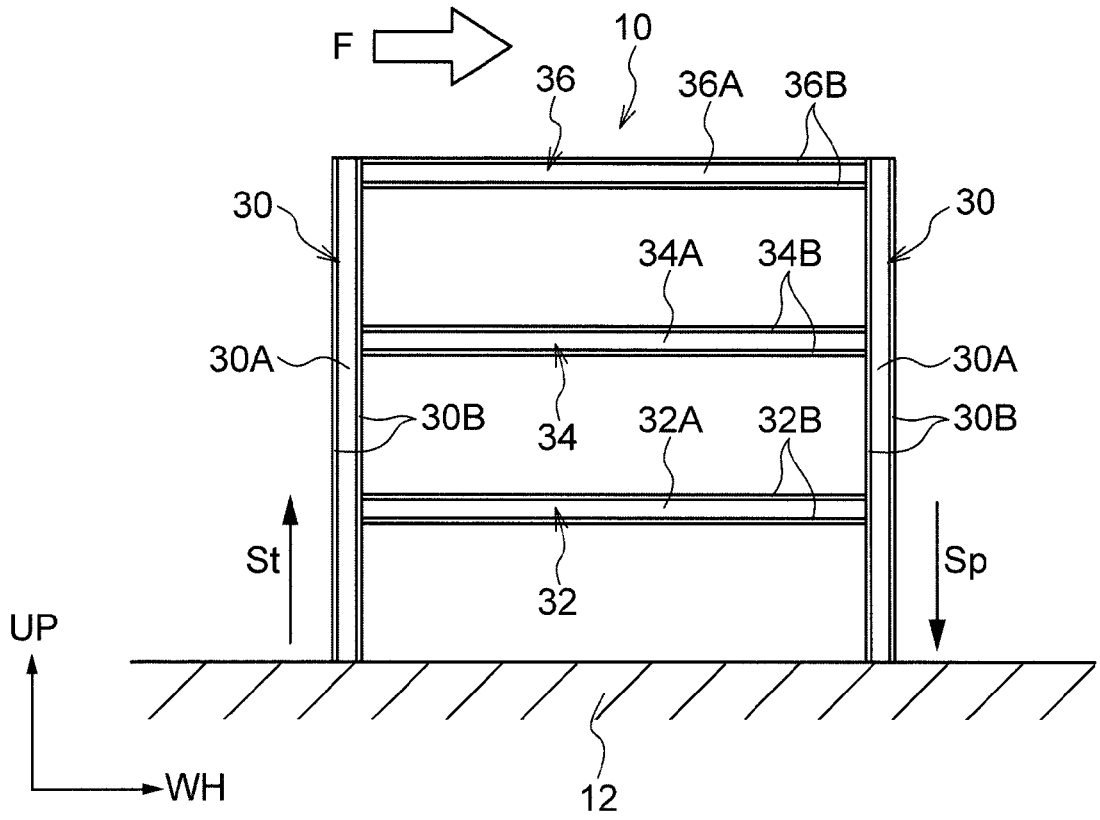
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FIG.4

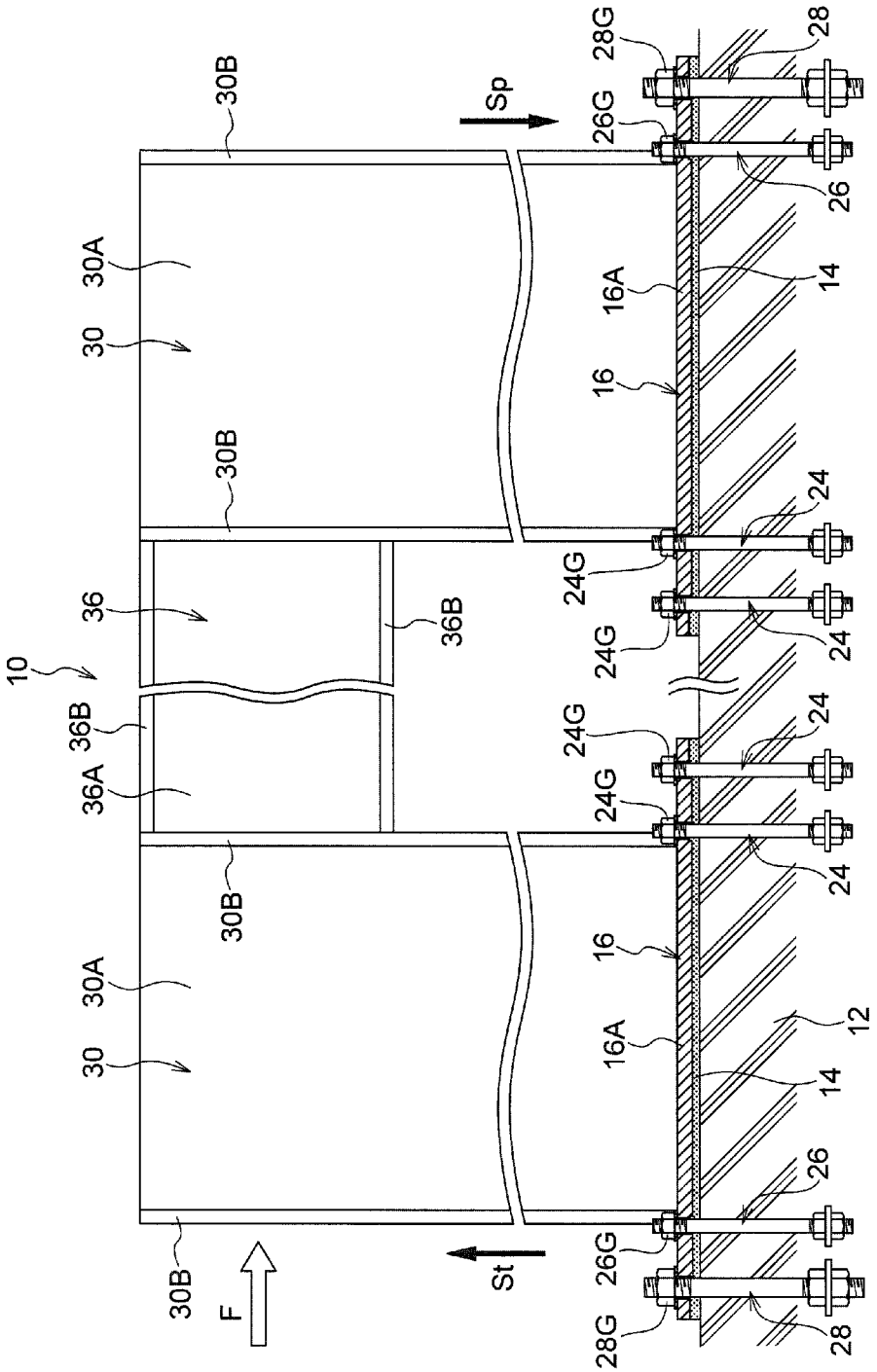
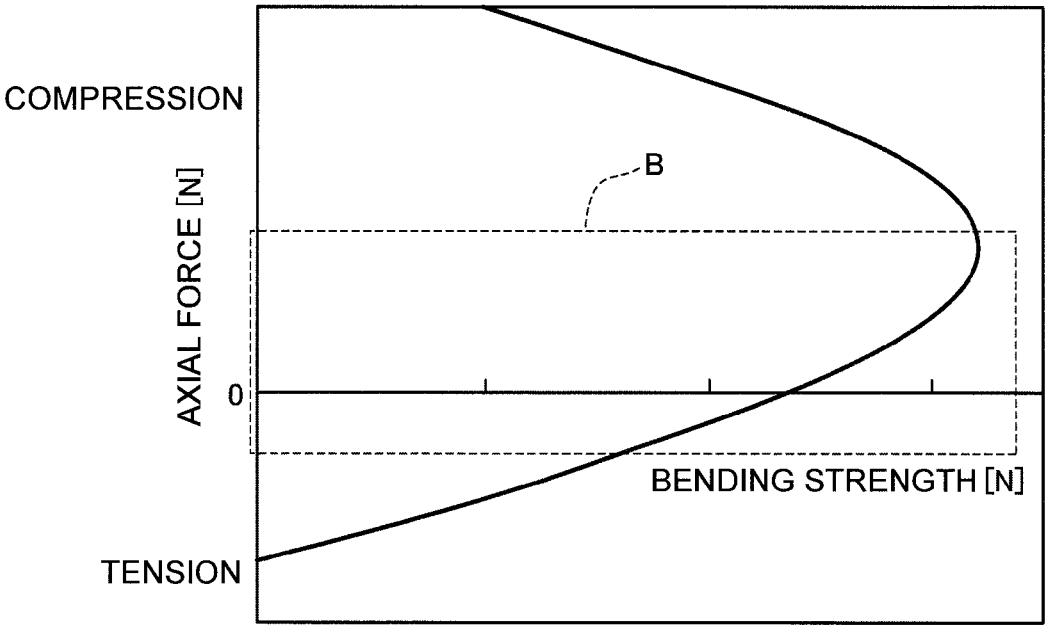


FIG.5



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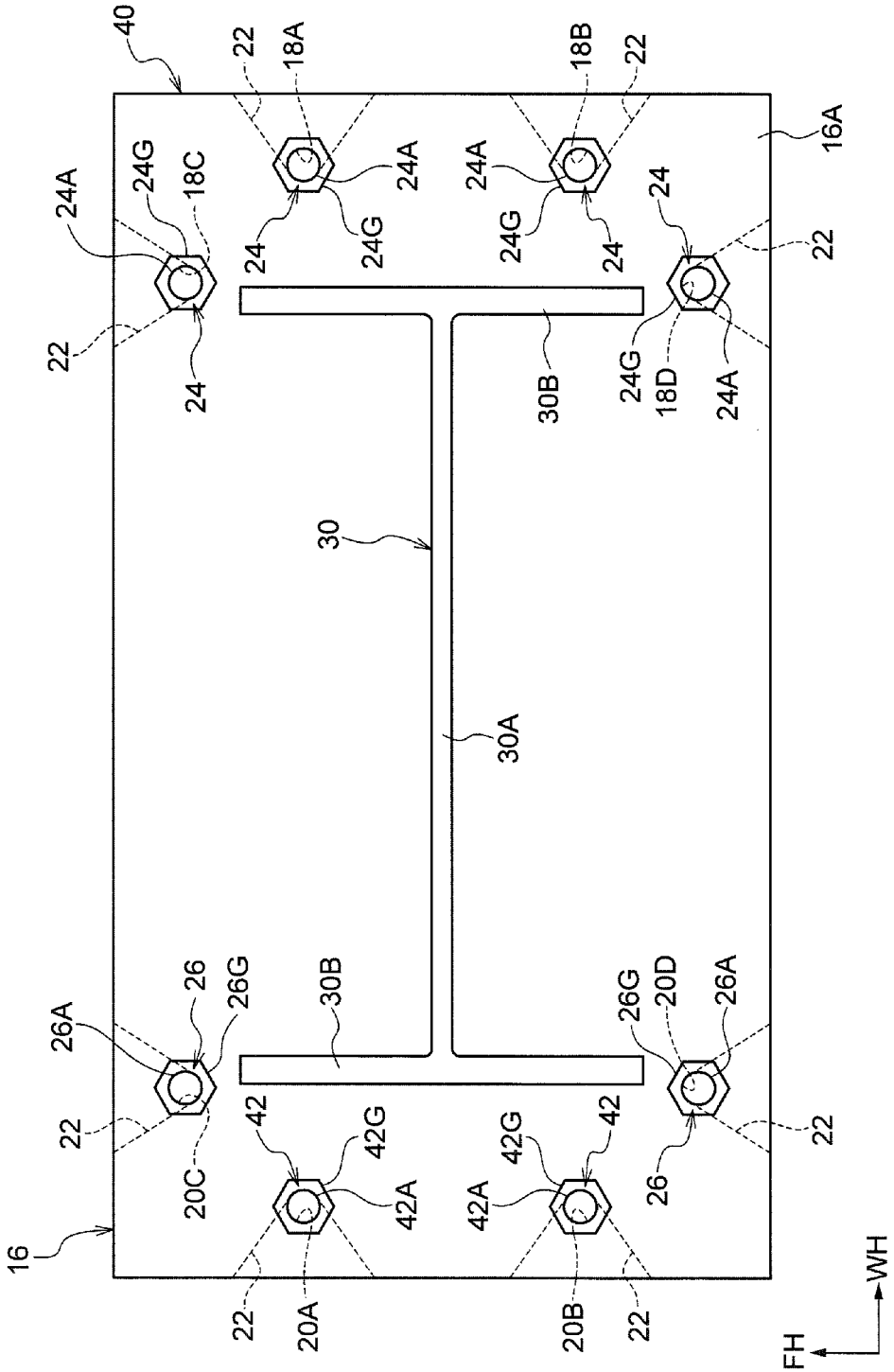
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18C
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30B
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20A
20B
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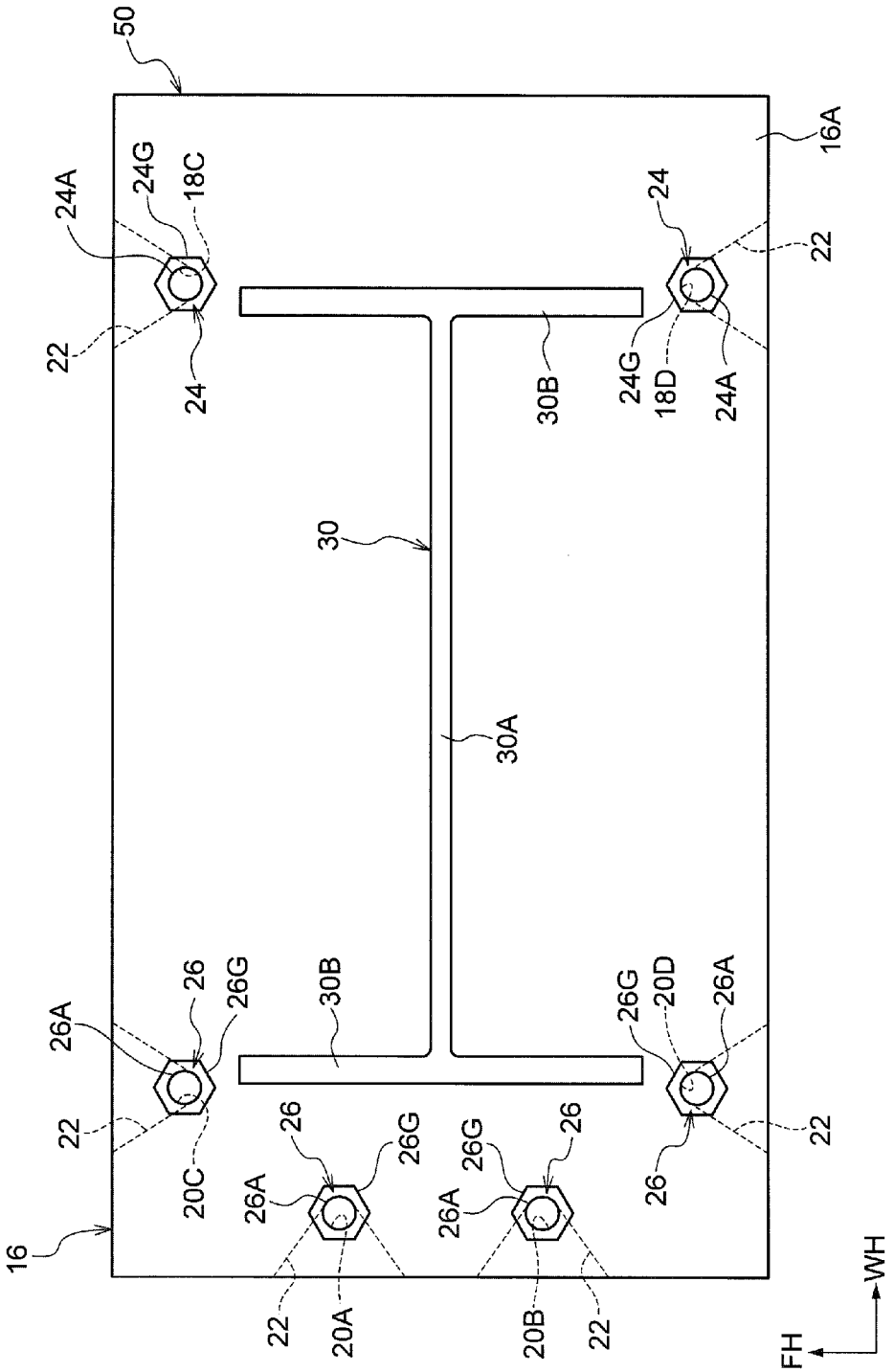
16
WH
FH

FIG.7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26G
20D
26A
22
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26A
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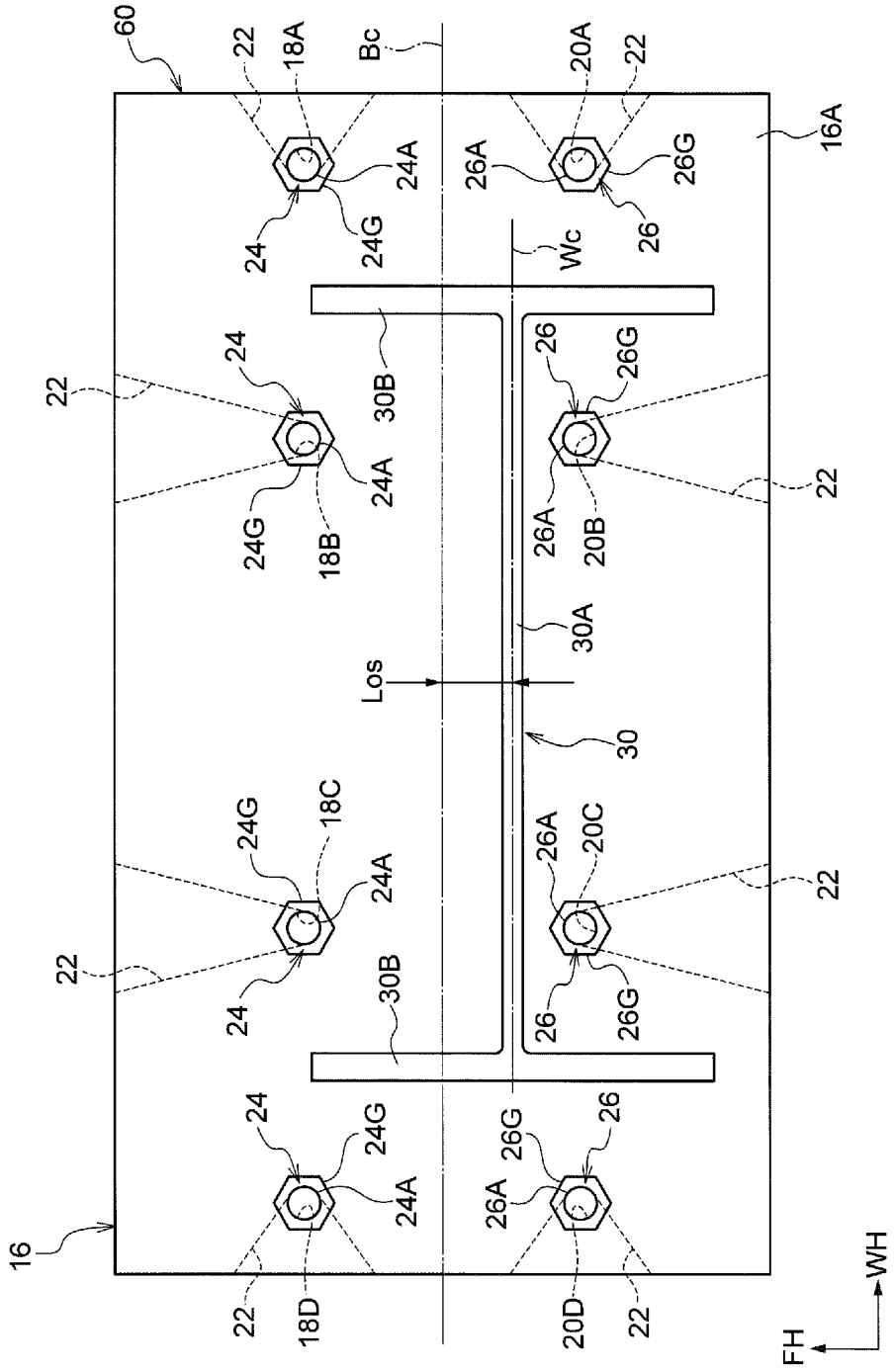
22
20A
20B
22
WH
FH

FIG.8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26A
20C
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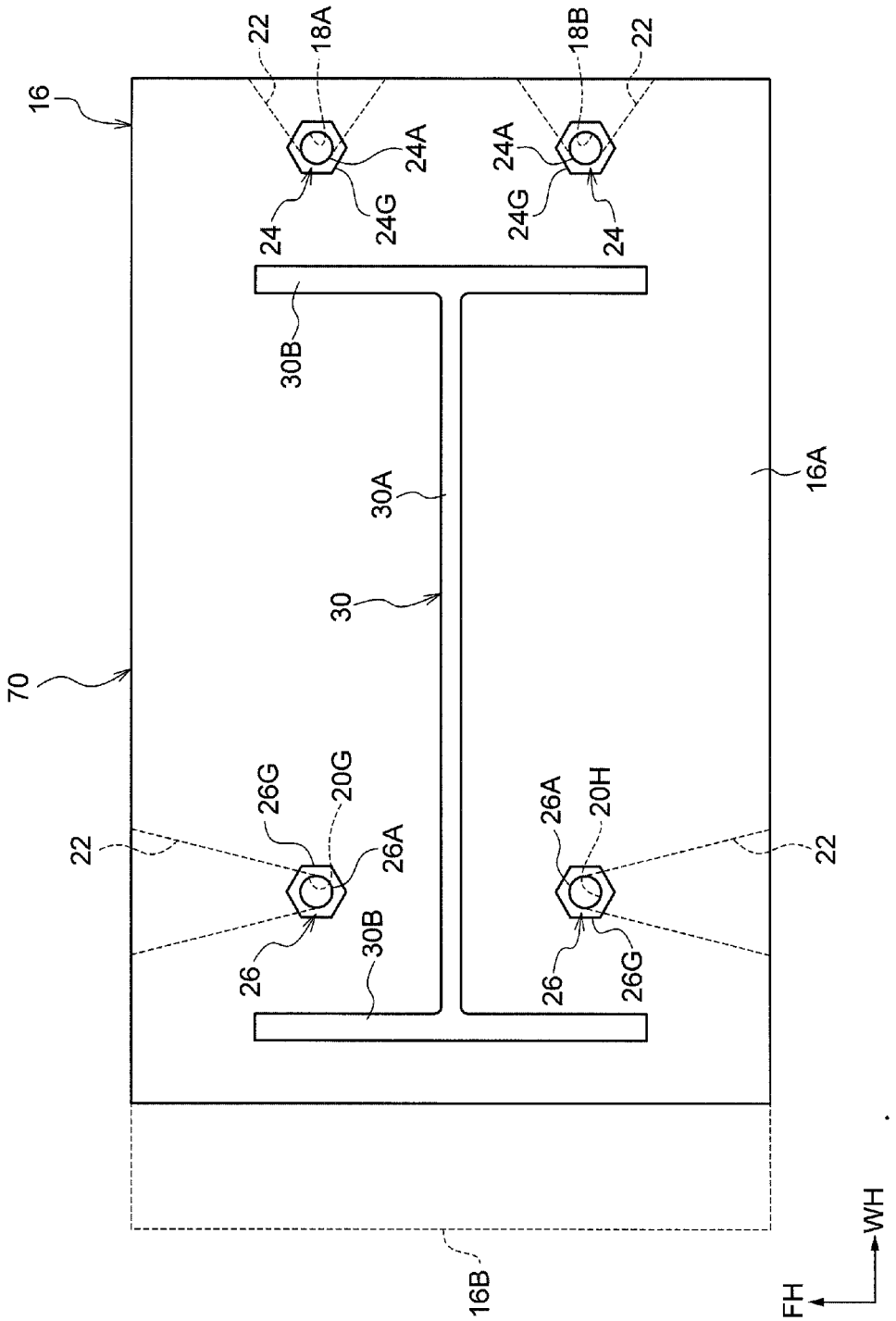
WH
FH

FIG.9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16B
WH
FH

FIG.10

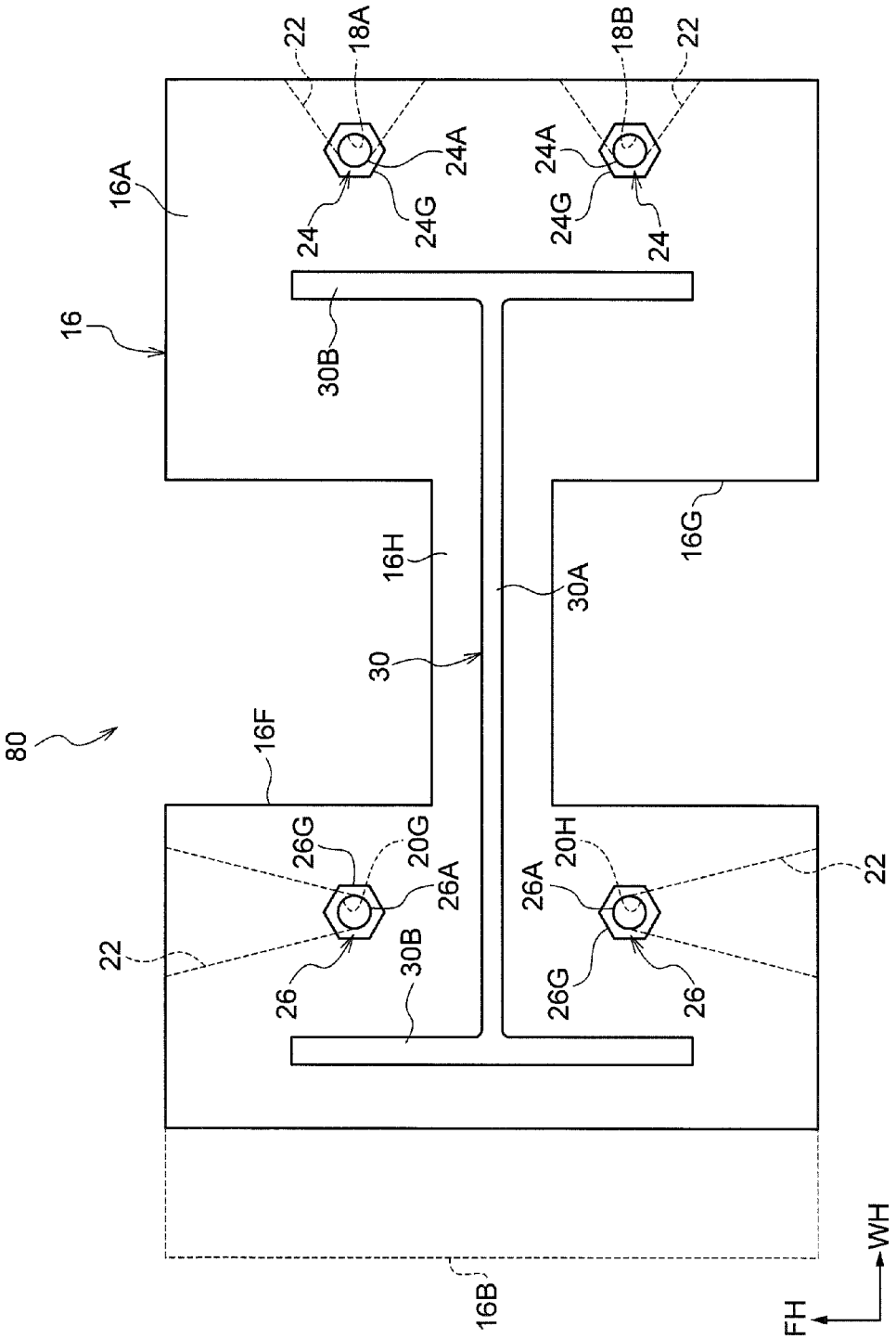
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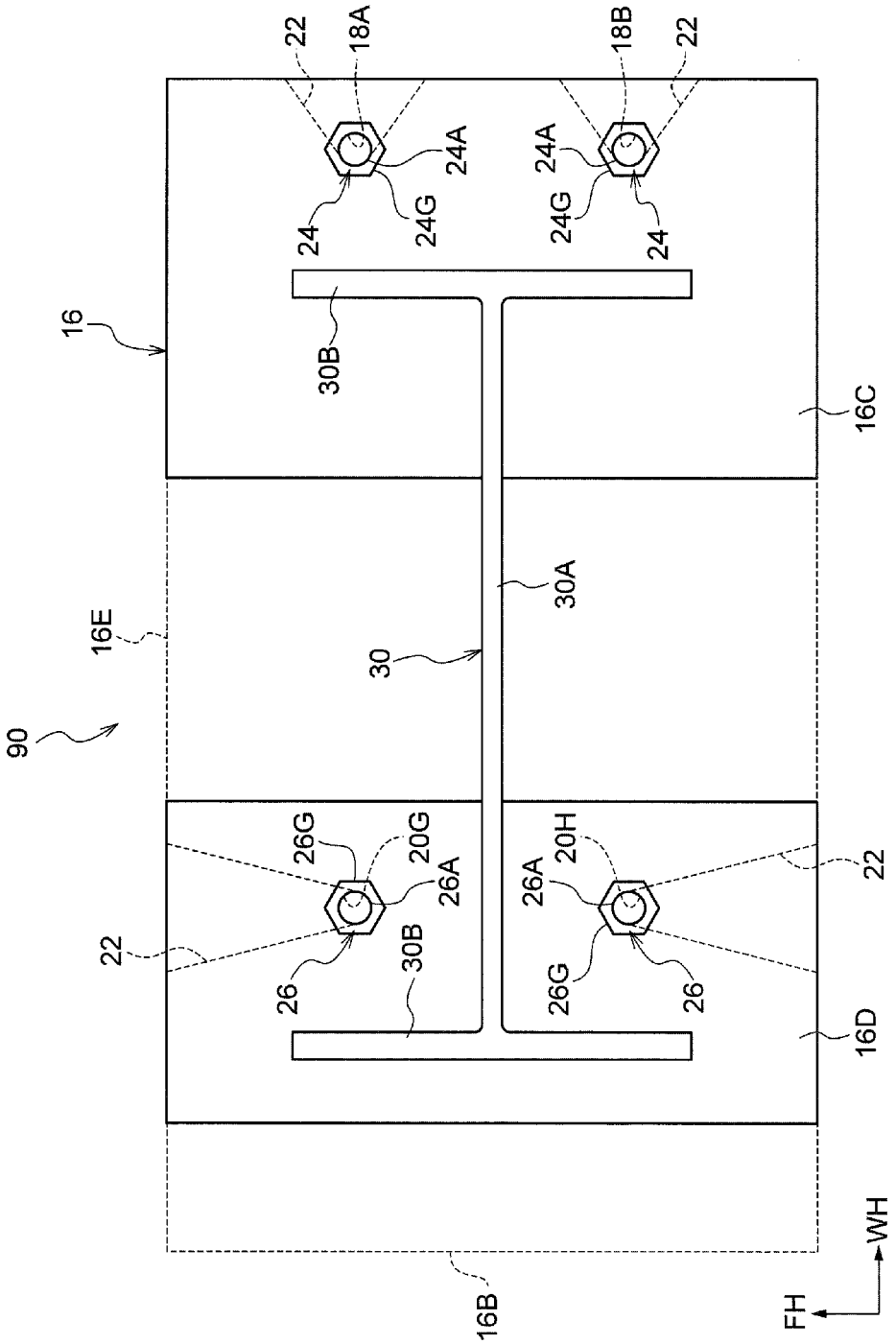
FIG.11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20G
20H
22
26A
26A
22
22
30B
26
26G
26
16D
16B
WH
FH

COLUMN STRUCTURE AND BASE MEMBER

TECHNICAL FIELD

The present invention relates to a column structure with a column member joined to the upper side of a base member, and to a base member that has an upper side for joining to a column member.

BACKGROUND ART

Japanese Patent Application Publication (JP-B) No. H6-19147 discloses a column base structure. In this column base structure, a base plate is joined to anchor bolts that are buried in a concrete foundation. A column is joined to the base plate, and the center of a projected outline of the column with respect to the horizontal plane is offset with respect to the center of a projected outline of the base plate with respect to the horizontal plane. In this column base structure, an out-of-plane deformation prevention means is provided to the base plate on the opposite side to the side to which the column is offset. The out-of-plane deformation prevention means is configured by washers, anchor bolts, or ribs. When bending moment arises in the column, the out-of-plane deformation prevention means prevents the base plate from undergoing out-of-plane deformation so as to deform such that the upper face projects out.

In the above column base structure, the column is offset and joined to the base plate, necessitating the out-of-plane deformation prevention means. The column base structure becomes more complicated as a result, leaving room for improvement.

DISCLOSURE OF INVENTION

Technical Problem

In consideration of the above circumstances, an object of the present invention is to obtain a column structure and a base member capable of raising column seat bending strength with a simple configuration.

Solution to Problem

A column structure of a first aspect of the present invention includes: a column member that is integrally provided with a flange at each of two width direction sides of a web; a base member that has the column member joined to an upper side of the base member; a first anchor member including a lower end side that is fixed to a foundation, and including an upper end side to which the base member is fixed at one width direction end side of the web, or at one width direction end side of the flange; and a second anchor member including a lower end side that is fixed to the foundation, and including an upper end side to which the base member is fixed at the other width direction end side of the web, or at the other width direction end side of the flange, the second anchor member having higher tensile strength than the first anchor member.

A column structure of a second aspect of the present invention is the column structure of the first aspect, wherein a shaft diameter of the second anchor member is formed larger than a shaft diameter of the first anchor member.

A column structure of a third aspect of the present invention is the column structure of the first aspect, wherein the second anchor member is formed from a material with higher tensile strength than the first anchor member material.

A column structure of a fourth aspect of the present invention is the column structure of the first aspect, wherein there are a greater number of the second anchor member formed than that of the first anchor member.

A column structure of a fifth aspect of the present invention is the column structure of the first aspect, wherein the first anchor member or the second anchor member includes: a first anchor bolt including an upper end side to which the base member is fixed at the opposite side of the flange to the web side; and a second anchor bolt including an upper end side to which the base member is fixed further toward the web width direction inside than the first anchor bolt, and that is disposed closer to the flange than the first anchor bolt.

A column structure of a sixth aspect of the present invention is the column structure of the first aspect, wherein the first anchor member is disposed at the inside of a building, and the second anchor member is disposed at the outside of the building.

A column structure of a seventh aspect of the present invention includes: a column member that is integrally provided with a flange at each of two width direction sides of a web; a base member that has the column member joined to an upper side of the base member, with a center position of the column member offset in the web width direction, or in the flange width direction, with respect to a center position of the base member; a first anchor member including a lower end side that is fixed to a foundation, and including an upper end side to which the base member is fixed at one width direction end side of the web; and a second anchor member including a lower end side that is fixed to the foundation, and including an upper end side to which the base member is fixed at the other width direction end side of the web, or at the other width direction end side the flange, the second anchor member having equivalent tensile strength to the first anchor member.

A column structure of an eighth aspect of the present invention is the column structure of the seventh aspect, wherein: the first anchor member upper end side is fixed to the base member at the opposite side of the flange to the web side, and the second anchor member upper end side is fixed to the base member at the web side of the flange.

A column structure of a ninth aspect of the present invention is the column structure of either the first aspect or the seventh aspect, wherein the base member includes a cutaway portion including a portion along the web that is cut away.

A column structure of a tenth aspect of the present invention is the column structure of either the first aspect or the seventh aspect, wherein the base member includes: a first base member that has one of the flanges joined to an upper side of the first base member, and that has the first anchor member upper end side fixed to the first base member; and a second base member that has the other of the flanges joined to an upper side of the second base member, and that has the second anchor member upper end side fixed to the second base member, with the second base member provided at a separation to the first base member.

A base member of an eleventh aspect of the present invention includes: a base body that has an upper side for joining to a column member integrally provided with a flange at each of two width direction sides of a web; a first fixing portion that is fixed to an upper end side of a first anchor member, the first anchor member being provided to the base body at one width direction end side of the web, or at one width direction end side of the flange, and including a lower end side that is fixed to a foundation; and a second fixing portion that is fixed to an upper end side of a second anchor member, the second anchor member being provided to the base body at the other width direction end side of the web, or at the other width direction

end side of the flange, including a lower end side that is fixed to the foundation, and having higher tensile strength than the first anchor member.

A base member of a twelfth aspect of the present invention includes: a base body that has an upper side for joining to a column member integrally provided with a flange at each of two width direction sides of a web, with a center position of the column member offset in the web width direction, or in the flange width direction; a first fixing portion that is fixed to an upper end side of a first anchor member, the first anchor member being provided to one web width direction end side of the base body and including a lower end side that is fixed to a foundation; a second fixing portion that is fixed to an upper end side of a second anchor member, the second anchor member being provided to the web width direction other end side of the base body and including a lower end side that is fixed to the foundation, and having equivalent tensile strength to the first anchor member.

A base member of a thirteenth aspect of the present invention is the base member of either the eleventh aspect or the twelfth aspect, wherein the base body includes a cutaway portion including a portion along the web that is cut away.

A base member of a fourteenth aspect of the present invention is the base member of either the eleventh aspect or the twelfth aspect, wherein the base body includes: a first base body that has one of the flanges joined to an upper side of the first base body, and that has the first anchor member upper end side fixed to the first base body; and a second base body that has the other of the flanges joined to an upper side of the second base body, and that has the second anchor member upper end side fixed to the second base body, with the second base body provided at a separation to the first base body.

Advantageous Effects of Invention

In the column structure of the first aspect of the present invention, the column member that is integrally provided with the flanges at each of two width direction sides of the web is joined to the upper side of the base member. The lower end sides of the first anchor member and the second anchor member are fixed to the foundation, and the base member is fixed to the upper end sides of the first anchor member and the second anchor member.

The upper end side of the first anchor member is fixed to the base member at one width direction end side of the web, or at one width direction end side of the flange. The upper end side of the second anchor member is fixed to the base member at the other width direction end side of the web, or at the other width direction end side of the flange, and the tensile strength of the second anchor member is higher than the tensile strength of the first anchor member. For example, when horizontal direction force acts on the column member from the other end side toward the one end side of the base member, a larger vertical direction tensile axial force arises at the other end side of the base member than at the one end side of the base member. Such a large tensile axial force is effectively suppressed by the second anchor member that has higher tensile strength. The column seat bending strength of the column structure can accordingly be raised by the simple configuration in which the tensile strength of the second anchor member is raised.

In the column structure of the second aspect of the present invention, the shaft diameter of the second anchor member is formed larger than the shaft diameter of the first anchor member. The tensile strength of the second anchor member can accordingly be raised, and the column seat bending strength of the column structure can be raised, by the simple configuration in which the shaft diameter is increased.

In the column structure of the third aspect of the present invention, the second anchor member is formed from a material with higher tensile strength than the first anchor member material. The tensile strength of the second anchor member can accordingly be raised, and the column seat bending strength of the column structure can be raised, by the simple configuration in which a material with higher tensile strength is employed.

In the column structure of the fourth aspect of the present invention, there is a greater number of the second anchor member formed than that of the first anchor member. The tensile strength of the second anchor member can accordingly be raised, and the column seat bending strength of the column structure can be raised, by the simple configuration in which the number of the second anchor member is increased.

In the column structure of the fifth aspect of the present invention, the first anchor member or the second anchor member includes the first anchor bolt and the second anchor bolt. The upper end side of the first anchor bolt is fixed to the base member at the opposite side of the flange to the web side. The upper end side of the second anchor bolt is fixed to the base member further toward the web width direction inside than the first anchor bolt. Since the second anchor bolt is disposed closer to the flange than the first anchor bolt, the distance between the column member and the second anchor bolt is reduced. The thickness of the base member is determined by the tensile strength of the second anchor bolt and the distance between the second anchor bolt and the column member. The thickness of the base member can accordingly be reduced due to reducing the distance between the second anchor bolt and the column member.

In the column structure of the sixth aspect of the present invention, the first anchor bolt is disposed at the inside of the building, and the second anchor member is disposed at the outside of the building. For example, when horizontal direction force acts on the column member from the building outside toward the building inside, a larger vertical direction tensile axial force arises in the second anchor member that is at the building outside. Such a large tensile axial force is effectively suppressed by the second anchor member that has high tensile strength. The column seat bending strength of the column structure can accordingly be raised by the simple configuration in which the strength of the second anchor member is raised.

In the column structure of the seventh aspect of the present invention, the column member that is integrally provided with the flange at each of two width direction sides of the web is joined to the upper side of the base member. The lower end sides of the first anchor member and the second anchor member are fixed to the foundation, and the base member is fixed to the upper end sides of the first anchor member and the second anchor member.

The first anchor member and the second anchor member have equivalent tensile strength to one another, the upper end side of the first anchor member is fixed to the one end side of the base member, and the upper end side of the second anchor member is fixed to the other end side of the base member. The center position of the column member is offset in the web width direction, or in the flange width direction, thereby reinforcing the base member with the column member at the offset location of the column member. For example, when horizontal direction force acts on the column member from the opposite side to the offset direction of the column member, a large vertical direction tensile axial force arises in the column member at the base member at the column member

offset location. Such a large tensile axial force is effectively suppressed by the reinforced location of the base member where the column member is offset. The column seat bending strength of the column structure can accordingly be raised by the simple configuration in which the column member is offset and joined to the base member.

In the column structure of the eighth aspect of the present invention the second anchor member upper end side is fixed to the base member at the web side of the flange, thereby enabling a location on the opposite side of the flange to the web side to be omitted at the other end side of the base member. The center position of the column member can accordingly be simply offset with respect to the center position of the base member, since the center position of the base member is moved toward the one end side of the base member with respect to the center position of the column member.

The column member of the ninth aspect of the present invention the base member includes the cutaway portion, thereby enabling a location of the base member corresponding to the cutaway to be omitted, enabling a reduction in weight of the base member.

In the column structure of the tenth aspect of the present invention, the base member includes the first base member that is joined to one of the flanges and the second base member that is joined to the other of the flanges, and the first base member and the second base member are at a separation to each other. A location of the base member between the first base member and the second base member can accordingly be omitted, reducing the weight of the base member.

In the base member of the eleventh aspect of the present invention the column member that is integrally provided with the flange at each of two width direction sides of the web is joined to the upper side of the base body. The lower end sides of the first anchor member and the second anchor member are fixed to the foundation, and the upper end side of the first anchor member is fixed to the first fixing portion of the base body, and the upper end side of the second anchor member is fixed to the second fixing portion of the base body.

The upper end side of the first anchor member is fixed to the first fixing portion at one width direction end side of the web, or at one width direction end side of the flange. The upper end side of the second anchor member is fixed to the second fixing portion of the base body at the web other width direction end side, or at the flange other width direction end side, and the tensile strength of the second anchor member is higher than the tensile strength of the first anchor member. For example, when horizontal direction force acts on the column member from the other end side toward the one end side of the base body, a larger vertical direction tensile axial force arises on the column member at the other end side than at the one end side of the base body. Such a large tensile axial force is effectively suppressed by the second anchor member that is fixed to the second fixing portion and has high tensile strength. The column seat bending strength of a column structure can accordingly be raised by the simple configuration in which the second anchor member with high tensile strength is fixed to the second fixing portion of the base body.

In the base member of the twelfth aspect of the present invention, the column member that is integrally provided with the flanges at each of two width direction sides of the web is joined to the upper side of the base body. The lower end sides of the first anchor member and the second anchor member are fixed to the foundation, and the upper end side of the first anchor member is fixed to the first fixing portion of the base body, and the upper end side of the second anchor member is fixed to the second fixing portion of the base body.

The first anchor member and the second anchor member have equivalent tensile strength to one another, the upper end side of the first anchor member is fixed to the first fixing portion of the base body, and the upper end side of the second anchor member is fixed to the second fixing portion of the base body. The center position of the column member is offset in the web width direction, or in the flange width direction, and the base body is reinforced by the column member at the offset location of the column member. For example, when horizontal direction force acts on the column member from the opposite side to the offset direction of the column member, a large vertical direction tensile axial force arises on the column member at the base body at the offset location of the column member. Such a large tensile axial force is effectively suppressed by the location of the base body reinforced by the offset column member. The column seat bending strength of the column structure can accordingly be raised by the simple configuration in which the column member is joined to the base body at an offset.

In the base member of the thirteenth aspect of the present invention, the base body includes the cutaway portion, thereby enabling a location of the base body corresponding to the cutaway to be omitted, and reducing the weight of the base body.

In the base member of the fourteenth aspect of the present invention, the base body includes the first base body that is joined to the one of the flanges, and the second base body that is joined to the other of the flanges. The first base body and the second base body are disposed at a separation to each other. A location of the base member between the first base body and the second base body can accordingly be omitted, reducing the weight of the base member.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a cross-section of a column structure and base member according to a first exemplary embodiment of the present invention, as viewed along a flange width direction (taken along line A-A in FIG. **2**).

FIG. **2** is a plan view of a column structure and a base member according to the first exemplary embodiment of the present invention.

FIG. **3** is a schematic side view of a building applied with a column structure and a base member according to the first exemplary embodiment.

FIG. **4** is an enlarged side view of relevant portions of the building illustrated in FIG. **3**.

FIG. **5** is a drawing illustrating a relationship between axial force of a column member and column seat bending strength in a column structure and a base member according to the first exemplary embodiment.

FIG. **6** is a plan view corresponding to FIG. **2** of a column structure and a base member according to a second exemplary embodiment of the present invention.

FIG. **7** is a plan view corresponding to FIG. **2** of a column structure and a base member according to a third exemplary embodiment of the present invention.

FIG. **8** is a plan view corresponding to FIG. **2** of a column structure and a base member according to a fourth exemplary embodiment of the present invention.

FIG. **9** is a plan view corresponding to FIG. **2** of a column structure and a base member according to a fifth exemplary embodiment of the present invention.

FIG. **10** is a plan view corresponding to FIG. **2** of a column structure and a base member according to a sixth exemplary embodiment of the present invention.

FIG. **11** is a plan view corresponding to FIG. **2** of a column structure and a base member according to a seventh exemplary embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

First Exemplary Embodiment

Explanation follows regarding a column structure and a base member according to a first exemplary embodiment of the present invention, with reference to FIG. **1** to FIG. **5**. Note that in the present exemplary embodiment an H-section structural steel column (H-section steel column) is employed as a column member, and in the drawings the arrow WH direction indicates a width direction of a web of the column member, and the arrow FH direction indicates a width direction of flanges of the column member as appropriate. The arrow UP direction indicates upwards.

Column Structure and Base Member Configuration

As illustrated in FIG. **1** and FIG. **2**, a column structure **10** according to the present exemplary embodiment is placed on a foundation **12**. The foundation **12** is, for example, concrete, and an upper face of the foundation **12** is formed as a horizontal and flat plane shape. Although not illustrated in the drawings, reinforcement is laid inside the foundation **12**, raising the strength of the foundation **12**.

Mortar **14** is provided as a fixing member on the upper surface of the foundation **12**. The mortar **14** is formed, for example, in a rectangular shape in plan view.

A base member **16** is fixed to an upper face of the mortar **14**. The base member **16** is provided with a base plate **16**A, as a base body. The mortar **14** is disposed across the entire lower side of the base plate **16**A. The base plate **16**A is configured in a rectangular flat plate shape with its length direction along the arrow WH direction and its short direction along the arrow FH direction. More specifically, the base plate **16**A is formed from a metal material, for example SN490B hot-rolled structural steel plate for construction according to Japanese Industrial Standard (JIS) specification G3136, or cast steel.

Two first fixing holes, a first fixing hole **18**A, a first fixing hole **18**B, and two second fixing holes, a second fixing hole **18**C and a second fixing hole **18**D are provided as first fixing portions at one length direction end portion of the base plate **16**A, illustrated on the right hand side in FIG. **1** and FIG. **2**. The first fixing hole **18**A and the first fixing hole **18**B are provided at intermediate portions in the base plate **16**A short direction. The second fixing hole **18**C and the second fixing hole **18**D are provided at both end portions in the base plate **16**A short direction. The first fixing hole **18**A, the first fixing hole **18**B, the second fixing hole **18**C and the second fixing hole **18**D are formed as circular shaped through holes having the same diameter in plan view.

The position of the center axis of the first fixing hole **18**A and the position of the center axis of the first fixing hole **18**B are aligned with each other along the arrow FH direction. The position of the center axis of the second fixing hole **18**C and the position of the center axis of the second fixing hole **18**D are aligned with each other along the arrow FH direction. In addition, the positions of the center axes of the second fixing hole **18**C and the second fixing hole **18**D are configured more toward a length direction central portion of the base plate **16**A so as to be further toward the arrow WH direction inside than the positions of the center axes of the first fixing hole **18**A and the first fixing hole **18**B. Moreover, the position of the center axis of the second fixing hole **18**C is further to the arrow FH outside than the position of the center axis of the first fixing hole **18**A. The position of the center axis of the second fixing hole **18**D is further to the arrow FH direction outside than the position of the center axis of the first fixing hole **18**B.

The other length direction end portion of the base plate **16**A illustrated on the left hand side in FIG. **1** and FIG. **2** is provided with two first fixing holes, a first fixing hole **20**A and a first fixing hole **20**B and two second fixing holes, a second fixing hole **20**C and a second fixing hole **20**D, respectively serving as second fixing portions. The first fixing hole **20**A and the first fixing hole **20**B are provided at a short direction intermediate portion of the base plate **16**A. The second fixing hole **20**C and the second fixing hole **20**D are provided at both end portions in the base plate **16**A short direction. The second fixing hole **20**C and the second fixing hole **20**D are formed as circular shaped through holes having the same diameter in plan view, and are configured with the same diameter as the first fixing holes **18**A to **18**D. The first fixing hole **20**A and the first fixing hole **20**B are formed as circular shaped through holes having the same diameter in plan view, and are configured with a larger diameter than the second fixing hole **20**C and the second fixing hole **20**D in the present exemplary embodiment. In other words, the diameters of the first fixing hole **20**A and the first fixing hole **20**B are formed larger than the diameters of the second fixing hole **20**C and the second fixing hole **20**D.

The position of the center axis of the first fixing hole **20**A and the position of the center axis of the first fixing hole **20**B are aligned with each other along the arrow FH direction. The position of the center axis of the second fixing hole **20**C and the position of the center axis of the second fixing hole **20**D are aligned with each other along the arrow FH direction. In addition, the positions of the center axes of the second fixing hole **20**C and the second fixing hole **20**D are configured further toward a length direction central portion of the base plate **16**A so as to be further toward the arrow WH direction inside than the positions of the center axes of the first fixing hole **20**A and the first fixing hole **20**B. The position of the center axis of the second fixing hole **20**C is further to the arrow FH direction outside than the position of the center axis of the first fixing hole **20**A. Moreover, the position of the center axis of the second fixing hole **20**D is further toward the arrow FH direction outside than the position of the center axis of the first fixing hole **20**B.

The position of the center axis of the first fixing hole **20**A is aligned with the position of the center axis of the first fixing hole **18**A along the arrow WH direction, and the position of the center axis of the first fixing hole **20**B is aligned with the position of the center axis of the first fixing hole **18**B along the arrow WH direction. The position of the center axis of the second fixing hole **20**C is aligned with the position of the center axis of the second fixing hole **18**C along the arrow WH direction, and the position of the center axis of the second fixing hole **20**D is aligned with the position of the center axis of the second fixing hole **18**D along the arrow WH direction.

The base plate **16**A is thereby provided with the four fixing holes of the first fixing hole **18**A, the first fixing hole **18**B, the second fixing hole **18**C, and the second fixing hole **18**D, and the four fixing holes of the first fixing hole **20**A, the first fixing hole **20**B, the second fixing hole **20**C, and the second fixing hole **20**D, to give a total of eight fixing holes.

As illustrated in FIG. **1** and FIG. **2**, indented portions **22** are formed to the lower face of the base plate **16**A at the periphery of each of the eight fixing holes of the first fixing hole **18**A to the second fixing hole **20**D; the horizontal direction upper face (bottom face of the indented portions **22**) of each of the

indented portions **22** is configured with a flat plane shape. The indented portions **22** are formed in substantially triangular shapes in plan view, and gradually widen on progression toward the outer peripheral side of the base plate **16**A, with the indented portions **22** open to the outside of the outer periphery of the base plate **16**A. At base plate **16**A center side portions, the vertical direction peripheral face of each of the indented portions **22** is configured in the same plane as the inner face of the respective fixing holes of the first fixing hole **18**A to the second fixing hole **20**D. The mortar **14** fills the whole of the indented portions **22**, and the base plate **16**A is fixed by the mortar **14**.

A first anchor member is fixed to the foundation **12** at each of the first fixing portions of the base member **16**, and a second anchor member is fixed to the foundation **12** at each of the second fixing portions. The first anchor members include first anchor bolts (anchor locks) **24** and second anchor bolts (anchor locks) **24**. The second anchor members include first anchor bolts (anchor locks) **28** and second anchor bolts (anchor locks) **26**.

The first anchor bolts **24** and the second anchor bolts **24** of the first anchor members are each equipped with a circular rod shaped anchor body **24**A, with the anchor body **24**A disposed with its axial direction along the up-down direction. Except for an upper end portion **24**C, most of the anchor body **24**A, including a lower end portion **24**B, pierces through the mortar **14** and is buried in the foundation **12**. The first anchor bolts **28** of the second anchor members are each equipped with a circular rod shaped anchor body **28**A, with the anchor body **28**A disposed with its axial direction along the up-down direction. Except for an upper end portion **28**C, most of the anchor body **28**A, including a lower end portion **28**B, pierces through the mortar **14** and is buried in the foundation **12**. The second anchor bolts **26** of the second anchor members are each equipped with a circular rod shaped anchor body **26**A, with the anchor body **26**A disposed with its axial direction along the up-down direction. Except for an upper end portion **26**C, most of the anchor body **26**A, including a lower end portion **26**B, pierces through the mortar **14** and is buried in the foundation **12**.

A male thread is provided to the lower end portion **24**B of the anchor body **24**A of each of the first anchor bolts **24** and the second anchor bolts **24** of the first anchor members. Two nuts, a nut **24**D and a nut **24**E, are provided screwed onto the male thread in the up-down direction. A circular ring flat plate shaped fixing plate **24**F configuring an anchor portion is interposed between the nut **24**D and the nut **24**E, so as to project further to the outside than the shaft diameter of the anchor body **24**A. The fixing plate **24**F is fixed by tightening of the nut **24**D and the nut **24**E. The nut **24**D, the nut **24**E and the fixing plate **24**F are buried in the foundation **12**, and are configured to prevent the first anchor bolt **24** from being pulled out.

The upper end portions **24**C of the anchor bodies **24**A are respectively configured so as to pierce through and project out from the first fixing hole **18**A, the first fixing hole **18**B, the second fixing hole **18**C, and the second fixing hole **18**D of the base plate **16**A. A male thread is provided to the upper end portion **24**C, and a nut **24**G for fixing the base plate **16**A is screwed onto the male thread. A circular ring flat plate shaped washer **24**H is interposed between the base plate **16**A and the nut **24**G.

In the first anchor bolts **28** of the second anchor members, two nuts, a nut **28**D and a nut **28**E, are provided screwed onto a male thread provided to the lower end portion **28**B of the anchor body **28**A. A circular ring flat plate shaped fixing plate **28**F is interposed between the nut **28**D and the nut **28**E. The fixing plate **28**F is fixed by tightening of the nut **28**D and the nut **28**E. The nut **28**D, the nut **28**E and the fixing plate **28**F are buried in the foundation **12**, and are configured to prevent the first anchor bolt **28** from being pulled out. The upper end portions **28**C of the anchor bodies **28**A are respectively configured so as to pierce through and project out from the first fixing hole **20**A and the first fixing hole **20**B serving as second fixing portions of the base plate **16**A. A male thread is provided to the upper end portion **28**C, and a nut **28**G for fixing the base plate **16**A is screwed onto the male thread. A circular ring flat plate shaped washer **28**H is interposed between the base plate **16**A and the nut **28**G.

Similarly, in the second anchor bolts **26** of the second anchor members, two nuts, a nut **26**D and a nut **26**E, are screwed onto a male thread provided to the lower end portion **26**B of the anchor body **26**A. A circular ring flat plate shaped fixing plate **26**F is interposed between the nut **26**D and the nut **26**E. The fixing plate **26**F is fixed by tightening of the nut **26**D and the nut **26**E. The nut **26**D, the nut **26**E and the fixing plate **26**F are buried in the foundation **12**, and are configured to prevent the second anchor bolt **26** from being pulled out. The upper end portions **26**C of the anchor bodies **26**A are respectively configured so as to pierce through and project out from the second fixing hole **20**C and the second fixing hole **20**D of the base plate **16**A. A male thread is provided to the upper end portion **26**C, and a nut **26**G for fixing the base plate **16**A is screwed onto the male thread. A circular ring flat plate shaped washer **26**H is interposed between the base plate **16**A and the nut **26**G.

In the present exemplary embodiment, the first anchor bolts **24** and the second anchor bolts **24** of the first anchor members and the second anchor bolts **26** of the second anchor members are formed with the same diameters as each other, and with the same axial direction lengths. The first anchor bolts **28** of the second anchor members are for example configured with a larger axial diameter than the first anchor bolts **24** of the first anchor members, and are formed with high tensile strength. More precisely, the first anchor bolts **24**, the second anchor bolts **24**, the first anchor bolts **28** and the second anchor bolts **26** are for example formed from a carbon steel material having a tensile strength such as 400 N/mm^2, or 490 N/mm^2 as defined by JIS specification G3138. An anchor bolt formed from stainless steel having a tensile strength of 520 N/mm^2 as defined by JIS specification G4321 may also be employed therefor. The diameter of the first anchor bolts **24**, the second anchor bolts **24**, and the second anchor bolts **26** is for example set at 30 mm ("M30" in screw terms), and the diameter of the first anchor bolts **28** is for example set at 36 mm ("M36" in screw terms).

At a center portion on the upper face of the base plate **16**A, a steel column **30** is provided as a column member, with its length direction extending in the up-down direction. A lower end of the steel column **30** is joined, for example by arc welding, to the upper face of the base plate **16**A.

The steel column **30** is, in the present exemplary embodiment, formed from H-section steel, and includes a web **30**A and a pair of flanges **30**B that are integrally provided at the two width direction ends of the web **30**A. The web **30**A of the steel column **30** is formed in an elongated rectangular flat plate shape with its width direction running along the arrow WH direction and its length direction running along the arrow UP direction. The pair of flanges **30**B are each formed in an elongated rectangular flat plate shape with their width directions running along the arrow FH direction and with their length directions running along the arrow UP direction. The two ends of the web **30**A are integrally joined to width direction central portions of the flanges **30**B. The steel column **30**

is, for example formed from a rolled structural steel for use in construction as defined by JIS specification G3136, a rolled steel for use in welded structures as defined by JIS specification G3106, or a rolled steel for use in general purpose structures as defined by JIS specification G3101.

Note that normally there are plural of the column structures **10** provided in a building. Although not illustrated in the drawings, foundation beams span across between lower end portions of the steel columns **30** of adjacent column structures **10**, so as to arrange the main foundation beam layout.

Building Structure

FIG. **3** is a schematic side view illustrating a structure of a building constructed using the column structure **10** and the base member **16** according to the present exemplary embodiment. FIG. **4** is a side view illustrating a structure of relevant portions of the building.

In the column structure **10** illustrated on the left hand side in FIG. **3** and FIG. **4**, the first fixing hole **18**A, the first fixing hole **18**B, the second fixing hole **18**C and the second fixing hole **18**D (see FIG. **1** and FIG. **2**) serving as the first fixing portions of the base member **16** are disposed on the building inside (on the right hand side). The first anchor bolts **24** and the second anchor bolts **24** serving as the first anchor members are fixed to the base plate **16**A on the building inside. The first fixing hole **20**A, the first fixing hole **20**B, the second fixing hole **20**C and the second fixing hole **20**D (see FIG. **1** and FIG. **2**) serving as the second anchor members of the base member **16** are disposed on the building outside (left hand side). The first anchor bolts **28** and the second anchor bolts **26** serving as the second anchor members are fixed to the base plate **16**A on the building outside.

The column structure **10** illustrated on the right hand side in FIG. **3** and FIG. **4** is configured so as to be rotated through 180 degrees with respect to the left hand side column structure **10** about a center axial line, not illustrated in the drawings, that runs in the arrow UP direction of the building. Namely, in the right hand side column structure **10**, the first fixing hole **18**A, the first fixing hole **18**B the second fixing hole **18**C, and the second fixing hole **18**D serving as the first fixing portions of the base member **16** are disposed on the building inside (left hand side). The first anchor bolts **24** and the second anchor bolts **24** serving as the first anchor members are fixed to the base plate **16**A on the building inside. The first fixing hole **20**A, the first fixing hole **20**B, the second fixing hole **20**C and the second fixing hole **20**D serving as the second fixing portions of the base member **16** are disposed on the building outside (right hand side). The first anchor bolts **28** and the second anchor bolts **26** serving as the second anchor members are fixed to the base plate **16**A on the building outside.

Note that as illustrated in FIG. **3**, a first beam member **32**, a second beam member **34**, and a third beam member **36** are provided between the left hand side column structure **10** and the right hand side column structure **10** so as to partition each story. One end portion on the left side of the first beam member **32** is joined to the steel column **30** of the left hand side column structure **10** using arc welding or bolt fastening, and the other end portion on the right side of the first beam member **32** is joined to the steel column **30** of the right hand side column structure **10** by similar joining means. In the present exemplary embodiment, an H-section steel beam integrally provided with flanges **32**B at both width direction (arrow UP direction) ends of a web **32**A is employed as the first beam member **32**. Both end portions of the second beam member **34** are similarly joined to the respective steel columns **30** of the left and right side column structures **10**, and both end portions of the third beam member **36** are joined to the respective steel columns **30** of the left and right side column structures **10**. An H-section steel beam with a web **34**A and flanges **34**B is employed for the second beam member **34**, and an H-section steel beam with a web **36**A and flanges **36**B is employed for the third beam member **36**. Note that the first beam member **32**, the second beam member **34**, and the third beam member **36** may also be formed from beam members such as I-section steel beams or square section steel beams.

Operation and Advantageous Effects of the First Exemplary Embodiment

As illustrated in FIG. **1** and FIG. **2**, in the column structure **10** and the base member **16** according to the present exemplary embodiment, the steel column **30** integrally provided with the flanges **30**B at both width direction end portions of the web **30**A is joined to the upper side of the base plate **16**A. The lower end sides of the first anchor members and the second anchor members are fixed to the foundation **12**, and the base plate **16**A is fixed to the upper end sides of the first anchor members and the second anchor members.

The upper end sides of the first anchor bolts **24** and the second anchor bolts **24** serving as the first anchor members are fixed to the base plate **16**A at one width direction end side of the web **30**A. The upper end sides of the first anchor bolts **28** and the second anchor bolts **26** serving as the second anchor members are fixed to the base plate **16**A at the other width direction end side of the web **30**A. The tensile strength of the first anchor bolts **28** of the second anchor members is higher than the tensile strength of the first anchor bolts **24** of the first anchor members.

As illustrated in FIG. **1**, FIG. **3** and FIG. **4**, when a force F due to an earthquake or the like acting from the left hand side toward the right hand side in the arrow WH direction (horizontal direction) arises at the outer periphery of the building, at the left hand side column structure **10** of the building on which the force F acts, the greatest tensile axial force St arises at the flange **30**B on the steel column **30** outside. At the right hand side column structure **10** of the building, the greatest compression axial force Sp arises at the flange **30**B on the steel column **30** outside. In the event of an earthquake, the direction of the force F alternates back and forth, such that the tensile axial force St and the compression axial force Sp act alternately at the flange **30**B of the left hand side column structure **10** as the compression axial force Sp and the tensile axial force St act alternately at the flange **30**B of the right hand side column structure **10**.

FIG. **5** illustrates a relationship between the axial force (N) arising in the steel column **30** and column seat bending strength (N) in the column structure **10**. As illustrated in FIG. **5**, the column seat bending strength with respect to compression axial force arising in the steel column **30** is high, however the column seat bending strength with respect to tensile axial force in the steel column **30** is weak. There is accordingly a need to increase the column seat bending strength with respect to tensile axial force. Note that the region B surrounded by the broken line is the range of axial forces arising in a typical building, and there is a tendency toward weak column seat bending strength with respect to tensile axial force even within the region B.

In the column structure **10** and the base member **16** according to the present exemplary embodiment, the first fixing hole **20**A and the first fixing hole **20**B serving as the second fixing portions in the base plate **16**A on the building outside are configured with enlarged diameters. In addition, the first

anchor bolts **28** serving as second anchor members configured with greater tensile strength than the first anchor members are provided through the first fixing hole **20**A and the first fixing hole **20**B. Namely, second fixing portions of the base plate **16**A are provided with the second anchor members that have high tensile strength, the second anchor members thereby effectively suppressing a large tensile axial force from acting in the steel column **30**. The column seat bending strength of the column structure **10** can accordingly be raised by the simple configuration in which the tensile strength of the second anchor members, and in particular of the first anchor bolts **28**, is raised.

As illustrated in FIG. **1** and FIG. **2**, in the column structure **10** and the base member **16** according to the present exemplary embodiment the shaft diameter of the first anchor bolts **28** of the second anchor members is formed larger than the shaft diameter of the first anchor bolts **24** of the first anchor members. The tensile strength of the first anchor bolts **28** can accordingly be raised, and the column seat bending strength of the column structure **10** can be raised, by the simple configuration in which the shaft diameter of the first anchor bolts **28** is increased.

As illustrated in FIG. **1**, in the column structure **10** and the base member **16** according to the present exemplary embodiment, the base plate **16**A is fixed to the upper end portions **24**C of the second anchor bolts **24** of the first anchor members provided on the width direction inside of the web **30**A. Similarly, the base plate **16**A is fixed to the upper end portions **26**C of the second anchor bolts **26** of the second anchor members provided on the width direction inside of the web **30**A. As illustrated in FIG. **1** and FIG. **2**, the second anchor bolts **24** are brought closer to the flange **30**B of the steel column **30**, to give a small separation distance L between the flange **30**B and the second anchor bolts **24**. There is similarly a small separation distance between the flange **30**B and the second anchor bolts **26**. Explanation here focuses on the first anchor member side only. Increasing the total number of the first anchor bolts **24** and the second anchor bolts **24** provided to the base plate **16**A (or increasing the total number of the holes of the first fixing hole **18**A, the first fixing hole **18**B, the second fixing hole **18**C and the second fixing hole **18**D) necessitates an increase in the thickness (up-down direction thickness dimension) t of the base plate **16**A.

The total number of the first anchor bolts **24** and the second anchor bolts **24** provided at the periphery of one of the flanges **30**B of the base plate **16**A is denoted n. In the present exemplary embodiment, n equals 4. The yield tensile strength in the axial direction of the i^{th} first anchor bolt **24** or the second anchor bolt **24** in the arrow FH direction is denoted Ti. The arrow WH direction separation distance between the center axis of the i^{th} first anchor bolt **24** or second anchor bolt **24** and the flange **30**B is denoted Li. Moreover, the arrow FH direction dimension of the base plate **16**A (width dimension) is denoted B, the thickness of the base plate **16**A is denoted t, and the yield point of the base plate **16**A material is denoted σ. In this case, the base plate **16**A conforms to the following relationship expression (1).

$$\sum_{i=1}^{n} TiLi \leq B(t^2/6)\sigma$$

In the above relationship expression, reducing the separation distance Li on the left side reduces the thickness t on the right side. Namely, in the present exemplary embodiment, by actively reducing the separation distance Li, the thickness of the base plate **16**A can be made thinner. The material costs of the base plate **16**A can be reduced, thereby enabling a saving in material costs and manufacturing costs of the column structure **10**.

Moreover, in the column structure **10** and the base member **16** according to the present exemplary embodiment, the first anchor bolts **24** of the first anchor members are disposed on the building inside, and the first anchor bolts **28** of the second anchor members are disposed on the building outside. For example, when a tensile axial force arises in the steel column **30**, the larger tensile axial force arises on the building outside of the steel column **30**. The location (on the second fixing portion side) where tensile axial force acts in the base plate **16**A is fixed by the first anchor bolts **28** of the second anchor members that have high tensile strength. The large tensile axial force is thereby suppressed by the high tensile strength first anchor bolts **28**, thereby enabling the column seat bending strength of the column structure **10** to be raised.

Moreover, in the column structure **10** and the base member **16** according to the present exemplary embodiment, the indented portions **22** are provided at the base plate **16**A lower side. The mortar **14** fills the indented portions **22**, and the base plate **16**A is anchored to the foundation **12** through the mortar **14**. Thus when horizontal load arises such as during an earthquake, displacement of the base member **16** with respect to the foundation **12** can be suppressed. This thereby enables the shear capacity of the column structure **10** and the base member **16** to be raised since shear stress is suppressed from being transmitted from the steel column **30** to the foundation **12** through the base plate **16**A and the first anchor members and second anchor members.

Note that in the column structure **10** and the base member **16** of the present exemplary embodiment, the tensile strength is raised on the other end side with respect to the one end side in the arrow WH direction (web **30**A width direction) of the base plate **16**A illustrated in FIG. **2**. In the present exemplary embodiment, the tensile strength may be raised on the other end side with respect to one end side in the arrow FH direction (flanges **30**B width direction) of the base plate **16**A. In such cases, the force F acting on the building acts in the arrow FH direction.

Moreover, in the present exemplary embodiment the tensile strength is raised by the first fixing hole **20**A and the first fixing hole **20**B of the second fixing portions and the first anchor bolts **28** of the second anchor members. In addition, the diameter of the second fixing hole **20**C and the second fixing hole **20**D of the second fixing portions may be increased, and the shaft diameter of the second anchor bolts **26** may be increased, thereby increasing the overall tensile strength of the second fixing portions and also of the second anchor members.

Second Exemplary Embodiment

Explanation follows regarding a column structure and base member according to a second exemplary embodiment of the present invention, with reference to FIG. **6**. Note that in the present exemplary embodiment, as well as in subsequently described exemplary embodiments, configuration that is the same as configuration of the column structure **10** and the base member **16** according to the first exemplary embodiment is appended with the same reference numerals, and repetition of explanation of such configurations is omitted.

Column Structure and Base Member Configuration

As illustrated in FIG. **6**, in a column structure **40** and a base member **16** according to the present exemplary embodiment,

configuration of a first fixing hole **20**A and a first fixing hole **20**B of second fixing portions, and configuration of first anchor bolts **42** of second anchor members, respectively shown on the left hand side in the drawing, differ from the configuration of the first exemplary embodiment. Other configurations of the column structure **40** and the base member **16** according to the present exemplary embodiment are similar to configuration of the column structure **10** and the base member **16** according to the first exemplary embodiment.

More specifically, the first fixing hole **20**A and the first fixing hole **20**B of the column structure **40** and the base member **16** are formed as circular shaped through holes having the same diameter as the first fixing hole **18**A and the first fixing hole **18**B of the first fixing portions. Note that the first fixing hole **20**A and the first fixing hole **20**B are also formed with the same diameter as the second fixing hole **20**C and the second fixing hole **20**D of the second fixing portions and the second fixing hole **18**C and the second fixing hole **18**D of the first fixing portions.

The first anchor bolts **42** serving as second anchor members are configured with the same diameter as the first anchor bolts **24**, and are formed from a material with a higher tensile strength than the first anchor bolts **24**. Upper end portions **42**C of the first anchor bolts **42** are provided with a male thread similarly to the upper end portions **24**A of the anchor bolts **24**. Nuts **42**G are screwed onto the male thread of the first anchor bolts **42** that pierce the first fixing hole **20**A and the first fixing hole **20**B with washers, omitted from illustration, interposed. Similarly to the first anchor bolts **24**, lower end sides of the first anchor bolts **42**, omitted from illustration, are provided with double nuts and fixing plates that are fastened by the double nuts. The upper end sides of the first anchor bolts **42** are thereby fixed to the base plate **16**A.

For example, when the anchor bolts **24** are formed from a carbon steel material having a tensile strength of 400 N/mm^2 as defined by JIS specification G3138, the first anchor bolts **42** may be formed from a carbon steel material having a tensile strength of 490 N/mm^2. The first anchor bolts **42** may also be formed from a stainless steel material with a higher tensile strength than the first anchor bolts **24**.

Note that in the present exemplary embodiment, the second anchor bolts **26** serving as the second anchor members may be formed from a material with a high tensile strength similarly to the first anchor bolts **42**. The length of the second anchor bolts **42** and the length of the first anchor bolts **24** may differ from each other under the condition that the tensile strength of the first anchor bolts **42** is higher than that of the anchor bolts **24**.

Operation and Advantageous Effects of the Second Exemplary Embodiment

As illustrated in FIG. **6**, in the column structure **40** and the base member **16** according to the present exemplary embodiment, the first anchor bolts **42** of the second anchor members are formed from a material with a higher tensile strength than the anchor bolts **24** of the first anchor members. The tensile strength of the second anchor members can accordingly be raised, and column seat bending strength of the column structure **40** can be raised by the simple configuration in which the first anchor bolts **42** are formed from a material having high tensile strength.

In addition to the above operation and advantageous effects, the column structure **40** and the base member **16** according to the present exemplary embodiment can obtain similar operation and advantageous effects to those obtained by the column structure **10** and the base member **16** according to the first exemplary embodiment.

Third Exemplary Embodiment

Explanation follows regarding a column structure and base member according to a third exemplary embodiment of the present invention, with reference to FIG. **7**.

Column Structure and Base Member Configuration

As illustrated in FIG. **7**, in a column structure **50** and a base member **16** according to the present exemplary embodiment, configuration of first fixing portions and first anchor members illustrated on the right hand side in the drawing, and configuration of second fixing portions and second anchor members illustrated on the left hand side in the drawing differ from the configuration of the first exemplary embodiment. Other configurations of the column structure **50** and the base member **16** according to the present exemplary embodiment are similar to configuration of the column structure **10** and the base member **16** according to the first exemplary embodiment.

More specifically, the first fixing portions of the column structure **50** and the base member **16** are configured with the first fixing hole **18**A and the first fixing hole **18**B (see FIG. **1** and FIG. **2**) omitted, with two fixing holes, the second fixing hole **18**C and the second fixing hole **18**D. The second anchor bolts **24** serving as the first anchor members are provided to the second fixing hole **18**C and the second fixing hole **18**D respectively.

The second fixing portions are configured by two first fixing holes, the first fixing hole **20**A and the first fixing hole **20**B, and two second fixing holes, the second fixing hole **20**C and the second fixing hole **20**D. The first fixing hole **20**A and the first fixing hole **20**B are formed as circular shaped through holes having the same diameter as the second fixing hole **20**C and the second fixing hole **20**D, similarly to the first fixing hole **20**A and the first fixing hole **20**B (see FIG. **6**) of the second exemplary embodiment described above. The first fixing hole **20**A and the first fixing hole **20**B are moreover formed with the same diameter as the second fixing hole **18**C and the second fixing hole **18**D of the first fixing portions. First anchor bolts **26** and second anchor bolts **26** serving as second anchor members are provided to the total of four fixing holes, namely the first fixing hole **20**A, the first fixing hole **20**B, the second fixing hole **20**C, and the second fixing hole **20**D. The first anchor bolts **26** are formed with the same diameter and the equivalent tensile strength to the second anchor bolts **26**. Moreover, the first anchor bolts **26** are formed with the same diameter and the equivalent tensile strength to the first anchor bolts **24** of the first anchor members.

Namely, in the column structure **50** and the base member **16** according to the present exemplary embodiment, there are a greater number of the first anchor bolts **26** and the second anchor bolts **26** of the second anchor members provided than that of the first anchor members.

Operation and Advantageous Effects of the Third Exemplary Embodiment

As illustrated in FIG. **7**, in the column structure **50** and the base member **16** according to the present exemplary embodiment, there are a greater number of the second anchor members provided than that of the first anchor members. The tensile strength of the second anchor members can be raised, and the column seat bending strength of the column structure

50 can be raised, by the simple configuration in which the number (quantity) of the second anchor members is varied.

In addition to the above operation and advantageous effects, the column structure **50** and the base member **16** according to the present exemplary embodiment can obtain similar operation and advantageous effects to those obtained by the column structure **10** and the base member **16** according to the first exemplary embodiment.

Fourth Exemplary Embodiment

Explanation follows regarding a column structure and base member according to a fourth exemplary embodiment of the present invention, with reference to FIG. **8**.

Column Structure and Base Member Configuration

As illustrated in FIG. **8**, in a column structure **60** and a base member **16** according to the present exemplary embodiment, the steel column **30** is joined to the base plate **16**A with a flange **30**B width direction (arrow FH direction) center position Wc of the steel column **30** offset with respect to a flange **30**B width direction center position Bc of the base plate **16**A by a distance Los. Note that the center position Bc is a center position on the upper face of the base plate **16**A, and the center position Wc is a center position on a lower face of the steel column **30**. More specifically, in the present exemplary embodiment one end side of the base plate **16**A on the arrow FH direction upper side is disposed at the outside of a building, omitted from illustration, and the other end side of the base plate **16**A on the arrow FH direction lower side is disposed at the building inside. Namely, the steel column **30** is offset toward the side where the greatest tensile axial force arises.

In the present exemplary embodiment, two fixing holes of the first fixing hole **18**A and the first fixing hole **18**B serving as first fixing portions, and two fixing holes of the second fixing hole **18**C and the second fixing hole **18**D are provided on one end side of the base plate **16**A. The center axis positions of the first fixing hole **18**A, the first fixing hole **18**B, the second fixing hole **18**C and the second fixing hole **18**D are aligned with each other along the arrow WH direction, and the first fixing hole **18**A to the second fixing hole **18**D are formed with the same diameter as each other. The first fixing hole **18**A is disposed on the opposite side of the flange **30**B to the web **30**A. The first fixing hole **18**B is disposed further to the web **30**A width direction inside than the first fixing hole **18**A, and is disposed on the web **30**A side of the flange **30**B. The second fixing hole **18**D is disposed on the opposite side of the flange **30**B to the web **30**A. The second fixing hole **18**C is disposed further toward the web **30**A width direction inside than the second fixing hole **18**D, and is disposed on the web **30**A side of the flange **30**B.

First anchor bolts **24** serving as first anchor members are provided to the first fixing hole **18**A and the first fixing hole **18**B, and second anchor bolts **24** serving as first anchor members are provided to the second fixing hole **18**C and the second fixing hole **18**D. The first anchor bolts **24** and the second anchor bolts **24** all formed with the same diameter, and are all formed with equivalent tensile strength.

Two first fixing holes, a first fixing hole **20**A and a first fixing hole **20**B, and two second fixing holes, a second fixing hole **20**C and a second fixing hole **20**D that serve as second fixing portions are provided on the other end side of the base plate **16**A. The center axis positions of the first fixing hole **20**A, the first fixing hole **20**B, the second fixing hole **20**C and the second fixing hole **20**D are aligned with each other along the arrow WH direction, and the first fixing hole **20**A to the second fixing hole **20**D are formed with the same diameter as each other. The first fixing hole **20**A to the second fixing hole **20**D of the second fixing portions are moreover configured with the same diameter as the first fixing hole **18**A to the second fixing hole **18**D of the first fixing portions. The first fixing hole **20**A is disposed on the opposite side of the flange **30**B to the web **30**A, and the center axis position of the first fixing hole **20**A is aligned with the center axis position of the first fixing hole **18**A in the arrow FH direction. The first fixing hole **20**B is disposed further to the web **30**A width direction inside than the first fixing hole **20**A, and is disposed on the web **30**A side of the flange **30**B. The center axis position of the first fixing hole **20**B is aligned with the center axis position of the first fixing hole **18**B in the arrow FH direction. The second fixing hole **20**D is disposed on the opposite side of the flange **30**B to the web **30**A, and the center axis position of the second fixing hole **20**D is aligned with the center axis position of the second fixing hole **18**D in the arrow FH direction. The second fixing hole **20**C is disposed further toward the web **30**A width direction inside than the second fixing hole **20**D, and is disposed on the web **30**A side of the flange **30**B.

First anchor bolts **26** serving as second anchor members are provided to the first fixing hole **20**A and the first fixing hole **20**B, and second anchor bolts **26** serving as second anchor members are provided to the second fixing hole **20**C and the second fixing hole **20**D. The first anchor bolts **26** and the second anchor bolts **26** are all formed with the same diameter and the equivalent tensile strength to each other. The first anchor bolts **26** are moreover formed with the same diameter and the equivalent tensile strength to the first anchor bolts **24**. The first anchor bolts **24**, the second anchor bolts **24**, the first anchor bolts **26** and the second anchor bolts **26** are moreover all provided an equal distance from the center position Bc of the base plate **16**A.

Operation and Advantageous Effects of the Fourth Exemplary Embodiment

As illustrated in FIG. **8**, in the column structure **60** and the base member **16** according to the present exemplary embodiment, the steel column **30** with the flanges **30**B integrally provided to both width direction sides of the web **30**A is joined to the upper side of the base plate **16**A. The lower end sides of the first anchor members and the second anchor members are fixed to the foundation **12**, and the base plate **16**A is fixed to the upper end sides of the first anchor members and the second anchor members.

The first anchor bolts **24** and the second anchor bolts **24** of the first anchor members, and the first anchor bolts **26** and the second anchor bolts **26** of the second anchor members are formed with the equivalent tensile strength to each other. The upper end sides of the first anchor bolts **24** and the second anchor bolts **24** are fixed to the arrow FH direction one end side of the base plate **16**A, and the upper end sides of the first anchor bolts **26** and the second anchor bolts **26** are fixed to the arrow FH direction other end side of the base plate **16**A. The center position Wc of the steel column **30** is offset with respect to the center position Bc of the base plate **16**A in the flanges **30**B width direction, such that the steel column **30** reinforces the location (the other end side of the base plate **16**A) of the base plate **16**A where the steel column **30** is offset. For example, when force (force F illustrated in FIG. **1**, FIG. **3** and FIG. **4**) in the horizontal direction is imparted to the steel column **30** from the opposite side to the offset direction of the steel column **30**, a large tensile axial force in the arrow UP direction arises in the steel column **30** at the loca-

tion of the base plate **16**A where the steel column **30** is offset. This large tensile axial force is effectively suppressed by the location of the base plate **16**A reinforced by the offset steel column **30**. Accordingly, the column seat bending strength of the column structure **60** can be raised by the simple configuration in which the steel column **30** is joined to the base plate **16**A at an offset even when the first anchor members and the second anchor members have the equivalent tensile strength to each other (even without modification).

In addition to the above operation and advantageous effects, the column structure **60** and the base member **16** according to the present exemplary embodiment can obtain similar operation and advantageous effects to the operation and advantageous effects obtained by the column structure **10** and the base member **16** according to the first exemplary embodiment.

Note that in the column structure **60** and the base member **16** according to the present exemplary embodiment, configuration may be made such that the center position Bc of the base plate **16**A and the center position Wc of the column member are aligned with each other, with both positions being offset in the arrow WH direction. In such a case, the steel column **30** is offset toward the building outside with respect to the base plate **16**A. The first fixing hole **18**A, the first fixing hole **18**B, the first fixing hole **20**A, and the first fixing hole **20**B are disposed on the building inside, and are provided with the first anchor bolts **24** and the first anchor bolts **26**. Moreover, the second fixing hole **18**C, the second fixing hole **18**D, the second fixing hole **20**C, and the second fixing hole **20**D are disposed on the building outside, and are provided with the second anchor bolts **24** and the second anchor bolts **26**.

Fifth Exemplary Embodiment

Explanation follows regarding a column structure and base member according to a fifth exemplary embodiment of the present invention, with reference to FIG. **9**. The present exemplary embodiment is a modified example of the column structure **60** and the base member **16** according to the fourth exemplary embodiment.

Column Structure and Base Member Configuration

As illustrated in FIG. **9**, in a column structure **70** and a base member **16** according to the present exemplary embodiment, the first fixing portions are configured by two first fixing holes, the first fixing hole **18**A and the first fixing hole **18**B, disposed on the opposite side of the flange **30**B to the web **30**A. The first fixing hole **18**A and the first fixing hole **18**B are provided with the first anchor bolts **24** serving as first anchor members.

The second fixing portions are configured by two second fixing holes, a second fixing hole **20**G and a second fixing hole **20**H, disposed on the web **30**A side of the flange **30**B. The second fixing hole **20**G and the second fixing hole **20**H are provided with the second anchor bolts **26** serving as the second anchor members. The second anchor bolts **26** are formed with the same diameter and the equivalent tensile strength to the first anchor bolts **24**.

In the base plate **16**A according to the present exemplary embodiment, the second fixing hole **20**G and the second fixing hole **20**H are disposed on the web **30**A side of the flange **30**B, and a region **16**B on the opposite side of the flange **30**B to the web **30**A is omitted. As a result, the steel column **30** is offset with respect to the base plate **16**A toward the left hand side in the web **30**A width direction (in the arrow WH direction). The side to which the steel column **30** is offset is configured at the building outside.

Operation and Advantageous Effects of the Fifth Exemplary Embodiment

As illustrated in FIG. **9**, in the column structure **70** and the base member **16** according to the present exemplary embodiment, the upper end sides of the second anchor bolts **26** serving as the second anchor members are fixed to the base plate **16**A on the web **30**A side of the flange **30**B. The region **16**B of the base plate **16**A that is on the opposite side of the flange **30**B to the web **30**A can be omitted as a result.

As a result of omitting the region **16**B of the base plate **16**A, the arrow WH direction center position of the steel column **30** moves toward the other end side of the base plate **16**A with respect to the arrow WH center position of the base plate **16**A. The center position of the steel column **30** can thereby be simply configured so as to be offset with respect to the center position of the base plate **16**A.

Moreover, in the column structure **70** and the base member **16** according to the present exemplary embodiment, the region **16**B portion of the base plate **16**A is omitted (a building outside portion of the base plate **16**A is reduced), thereby achieving a reduction in weight of the base plate **16**A. Moreover, since the quantity of material required for manufacture of the base plate **16**A can be reduced, a reduction in manufacturing costs of the column structure **70** and the base member **16** is enabled.

Moreover, in the column structure **70** and the base member **16** according to the present exemplary embodiment, the region **16**B of the base plate **16**A on the opposite side of the flange **30**B to the web **30**A is omitted, thereby enabling the steel column **30** to be brought closer to an adjacent boundary. Efficient utilization of the building site is thereby enabled.

Sixth Exemplary Embodiment

Explanation follows regarding a column structure and base member according to a sixth exemplary embodiment of the present invention, with reference to FIG. **10**. The present exemplary embodiment is a modified example of the column structure **70** and the base member **16** according to the fifth exemplary embodiment.

Column Structure and Base Member Configuration

As illustrated in FIG. **10**, in a column structure **80** according to the present exemplary embodiment, a cutaway portion **16**F and a cutaway portion **16**G are provided to the base plate **16**A of the base member **16**.

More specifically, the cutaway portion **16**F is formed by cutting away a portion of the base plate **16**A along the web **30**A on one arrow FH direction end side of the base plate **16**A between the pair of flanges **30**B. The cutaway portion **16**F is configured in a U shape (rectangular shape) open toward the one end side of the base plate **16**A in plan view.

The cutaway portion **16**G is formed by cutting away a portion of the base plate **16**A along the web **30**A on the arrow FH direction other end side of the base plate **16**A between the pair of flanges **30**B. In plan view, the cutaway portion **16**G is configured in a U shape (rectangular shape) open toward the other end side of the base plate **16**A symmetrically to the cutaway portion **16**F.

A location of the base plate **16**A is provided between the cutaway portion **16**F and the cutaway portion **16**G, with the

web **30**A joined to this location. In plan view, the overall base plate **16**A has an H shape in the present exemplary embodiment.

Operation and Advantageous Effects of the Present Exemplary Embodiment

As illustrated in FIG. **10**, in the column structure **80** and the base member **16** according to the present exemplary embodiment, the base plate **16**A is provided with the cutaway portion **16**F and the cutaway portion **16**G. Locations equivalent to the cutaway portion **16**F and the cutaway portion **16**G can accordingly be omitted from the base plate **16**A, enabling a reduction in weight of the base plate **16**A.

In addition to the above operation and advantageous effects, the column structure **80** and the base member **16** according to the present exemplary embodiment can obtain similar operation and advantageous effects to those obtained by the column structure **70** and the base member **16** according to the fifth exemplary embodiment.

Note that the present exemplary embodiment may be applied to any out of the column structure **10** and the base member **16** according to the first exemplary embodiment to the column structure **60** and the base member **16** according to the fourth exemplary embodiment. The plan view shapes of the cutaway portion **16**F and the cutaway portion **16**G are not limited to U shapes, and may for example be configured with trapezoidal shapes or circular arc shapes. Moreover, slits may be formed in place of the cutaway portions.

Seventh Exemplary Embodiment

Explanation follows regarding a column structure and base member according to a seventh exemplary embodiment of the present invention, with reference to FIG. **11**. The present exemplary embodiment is a modified example of the column structure **70** and the base member **16** according to the fifth exemplary embodiment.

Column Structure and Base Member Configuration

As illustrated in FIG. **11**, in a column structure **90** according to the present exemplary embodiment, the base member **16** is configured from a first base member and a second base member. The first base member is provided with a first base plate **16**C serving as a base body, and the second base member is provided with a second base plate **16**D serving as a base body.

More specifically, the first base plate **16**C is configured in a rectangular flat plate shape with its length direction along the arrow FH direction and its short direction along the arrow WH direction. One of the flanges **30**B of the steel column **30** is joined to an upper end side of the first base plate **16**C. Moreover, two first fixing holes, the first fixing hole **18**A and the first fixing hole **18**B that serve as first fixing portions are disposed on the first base plate **16**C on the opposite side of the flange **30**B to the web **30**A side. First anchor bolts **24** serving as first anchor members are provided to the first fixing hole **18**A and the first fixing hole **18**B.

The second base plate **16**D is configured in a rectangular flat plate shape with its length direction along the arrow FH direction and its short direction along the arrow WH direction. The second base plate **16**D is provided at a separation to the first base plate **16**C. The other of the flanges **30**B of the steel column **30** is joined to an upper end side of the second base plate **16**D. Two second fixing holes, the second fixing hole **20**G and the second fixing hole **20**H, are disposed on the second base plate **16**D on the web **30**A side of the flange **30**B. Second anchor bolts **26** serving as second anchor members are provided to the second fixing hole **20**G and the second fixing hole **20**H.

Operation and Advantageous Effects of the Seventh Exemplary Embodiment

As illustrated in FIG. **11**, the column structure **90** and the base member **16** according to the present exemplary embodiment, are provided with the first base plate **16**C serving as the first base member that is joined to the one flange **30**B of the steel column **30**, and the second base plate **16**D serving as the second base member that is joined to the other flange **30**B of the steel column **30**. The first base plate **16**C and the second base plate **16**D are configured at a separation to one another. The surface area of the base member **16** can thereby be reduced by the amount of the separation between the first base plate **16**C and the second base plate **16**D. In FIG. **11**, the region enclosed by the by the broken line labelled **16**E is omitted. A reduction in weight of the base member **16** equivalent to the region **16**E can accordingly be achieved. Moreover, a reduction in the material required for manufacture of the base member **16** can be achieved. A reduction in the manufacturing costs of the column structure **90** and the base member **16** can also be achieved.

Moreover, in the column structure **90** and the base member **16** according to the present exemplary embodiment, a region **16**B of the second base plate **16**D on the opposite side of the flange **30**B to the web **30**A side is omitted, thereby enabling the steel column **30** to be brought closer to an adjacent boundary. Efficient utilization of the building site is thereby enabled.

Note that the present exemplary embodiment may be applied to any out of the column structure **10** and the base member **16** according to the first exemplary embodiment to the column structure **60** and the base member **16** according to the fourth exemplary embodiment. More specifically, for example in the column structure **10** and the base member **16** according to the first exemplary embodiment, the base plate **16**A may be split into the first base plate **16**C and a second base plate **16**D.

Other Exemplary Embodiments

The present invention is not limited to the exemplary embodiments described above, and various modifications are possible within a range not departing from the spirit of the present invention. For example, in the first exemplary embodiment illustrated in FIG. **2**, four fixing portions or anchor members are respectively provided to the base member along the flange width direction at both width direction end portions of the web. In the present invention, three or more fixing portions or anchor portions may be respectively provided to the one end portion and the other end portion in the base member length direction. When there are a minimum of three fixing portions or anchor members, one fixing portion or anchor member is provided at a flange width direction central portion, and one fixing portion or anchor member is provided at each flange width direction end portion. Moreover, when there are a minimum of three fixing portions or anchor members, configuration may be made such that two fixing portions or anchor members are provided at flange width direction central portions, and one fixing portion or anchor member is provided to one out of two flange width direction end portions. Moreover, in the present invention,

one anchor member with high tensile strength may be provided at the building outside, or three or more anchor members may be provided.

The invention claimed is:

1. A column structure comprising:
- a column member that is integrally provided with a flange at each of two width direction sides of a web;
- a base member having an upper side joined to the column member;
- a first anchor member including a lower end side that is fixed to a foundation, and including an upper end side to which the base member is fixed, the first anchor member being positioned:
- at one width direction end side of the flange and not positioned at an end opposite to the one width direction end side of the flange; and
- a second anchor member including a lower end side that is fixed to the foundation, and including an upper end side to which the base member is fixed, the second anchor member being positioned:
- at the other width direction end side of the flange, at which the first anchor member is not positioned and the second anchor member is not positioned at the one width direction end side of the flange at which the first anchor member is positioned,
- the second anchor member having higher tensile strength than the first anchor member,
- a third anchor member including a lower end side that is fixed to the foundation, and including an upper end side to which the base member is fixed, the third anchor member being positioned:
- at one width direction end side of the web and not positioned at an end opposite to the one width direction end side of the web,
- a fourth anchor member including a lower end side that is fixed to the foundation, and including an upper end side to which the base member is fixed, the fourth anchor member being positioned:
- at the other width direction end side of the web at which the third anchor member is not positioned and the fourth anchor member is not positioned at the one width direction end side of the web at which the third anchor member is positioned,
- the fourth anchor member having higher tensile strength than the third anchor member.

2. The column structure of claim 1, wherein a shaft diameter of the second anchor member is formed larger than a shaft diameter of the first anchor member.

3. The column structure of claim 1, wherein the second anchor member is formed from a material with higher tensile strength than the first anchor member material.

4. The column structure of claim 1, wherein the first anchor member and the second anchor member comprise multiple anchor members wherein there are a greater number of the second anchor member formed than that of the first anchor member.

5. The column structure of claim 1, wherein the first anchor member or the second anchor member comprises:
- a first anchor bolt including an upper end side, to which the base member is fixed at the opposite side of the flange from the web side; and
- a second anchor bolt including an upper end side, to which the base member is fixed further toward the web width direction inside than the first anchor bolt, and that is disposed closer to the flange than the first anchor bolt.

6. The column structure of claim 1, wherein the first anchor member is disposed at the inside of a building, and the second anchor member is disposed at the outside of the building.

7. The column structure of claim 1, wherein the base member comprises:
- a cutaway portion including a portion along the web that is cut away.

8. The column structure of claim 1, wherein the base member comprises:
- a first base member having an upper side joined to one of the flanges, and that has the first anchor member upper end side fixed to the first base member; and
- a second base member having an upper side joined to the other of the flanges, and that is fixed to the second anchor member upper end side, the second base member being provided at a separation from the first base member.

9. A base member comprising:
- a base body that has an upper side for joining to a column member integrally provided with a flange at each of two width direction sides of a web;
- a first fixing portion that is fixed to an upper end side of a first anchor member, the first anchor member being provided to the base body, and being positioned:
- at one width direction end side of the flange and not positioned at an end opposite to the one width direction end side of the flange, and including a lower end side that is fixed to a foundation; and
- a second fixing portion that is fixed to an upper end side of a second anchor member, the second anchor member being provided to the base body, and being positioned:
- at the other width direction end side of the flange at which the first anchor member is not positioned and the second anchor member is not positioned at the one width direction end side of the flange at which the first anchor member is positioned, including a lower end side that is fixed to the foundation, and having higher tensile strength than the first anchor member,
- a third anchor member including a lower end side that is fixed to the foundation, and including an upper end side to which the base member is fixed, the third anchor member being positioned:
- at one width direction end side of the web and not positioned at an end opposite to the one width direction end side of the web,
- a fourth anchor member including a lower end side that is fixed to the foundation, and including an upper end side to which the base member is fixed, the fourth anchor member being positioned:
- at the other width direction end side of the web at which the third anchor member is not positioned and the fourth anchor member is not positioned at the one width direction end side of the web at which the third anchor member is positioned,
- the fourth anchor member having higher tensile strength than the third anchor member.

10. The base member of claim 9, wherein the base body comprises:
- a cutaway portion including a portion along the web that is cut away.

11. The base member of claim 9, wherein the base body comprises:
- a first base body having an upper side joined to one of the flanges, and that is fixed to the first anchor member upper end side; and
- a second base body having an upper side joined to the other of the flanges, and that is fixed to the second anchor

member upper end side, with the second base body provided at a separation from the first base body.

12. A column structure comprising:

a column member that is integrally provided with a flange at each of two width direction sides of a web;

a base member having an upper side that is joined to the column member, a center position of the column member being offset in the web width direction, or in the flange width direction, with respect to a center position of the base member;

a first anchor member including a lower end side that is fixed to a foundation, and including an upper end side to which the base member is fixed at one width direction end side of the web; and

a second anchor member including a lower end side that is fixed to the foundation, and including an upper end side to which the base member is fixed at the other width direction end side of the web, or at the other width direction end side the flange, the second anchor member having equivalent tensile strength to the first anchor member, wherein:

the first anchor member upper end side is fixed to the base member at the opposite side of the flange to the web side, and the second anchor member upper end side is fixed to the base member at the web side of the flange, and

the base member comprises a first indented portion that is formed to the lower face of the base member at the position of the first anchor member and that opens away from the flange toward an outer periphery of the base member, and a second indented portion that is formed to the lower face of the base member at the position of the second anchor member and that opens away from the web toward an outer periphery of the base member,

wherein the base member comprises:

a cutaway portion including a portion along the web that is cut away.

13. A column structure comprising:

a column member that is integrally provided with a flange at each of two width direction sides of a web;

a base member having an upper side that is joined to the column member, a center position of the column member being offset in the web width direction, or in the flange width direction, with respect to a center position of the base member;

a first anchor member including a lower end side that is fixed to a foundation, and including an upper end side to which the base member is fixed at one width direction end side of the web; and

a second anchor member including a lower end side that is fixed to the foundation, and including an upper end side to which the base member is fixed at the other width direction end side of the web, or at the other width direction end side the flange, the second anchor member having equivalent tensile strength to the first anchor member, wherein:

the first anchor member upper end side is fixed to the base member at the opposite side of the flange to the web side, and the second anchor member upper end side is fixed to the base member at the web side of the flange, and

the base member comprises a first indented portion that is formed to the lower face of the base member at the position of the first anchor member and that opens away from the flange toward an outer periphery of the base member, and a second indented portion that is formed to the lower face of the base member at the position of the second anchor member and that opens away from the web toward an outer periphery of the base member,

wherein the base member comprises:

a first base member having an upper side joined to one of the flanges, and that has the first anchor member upper end side fixed to the first base member; and

a second base member having an upper side joined to the other of the flanges, and that is fixed to the second anchor member upper end side, the second base member being provided at a separation from the first base member.

14. A base member comprising:

a base body that has an upper side for joining to a column member integrally provided with a flange at each of two width direction sides of a web, with a center position of the column member offset in the web width direction or in the flange width direction;

a first fixing portion that is fixed to an upper end side of a first anchor member, the first anchor member being provided to one web width direction end side of the base body and including a lower end side that is fixed to a foundation;

a second fixing portion that is fixed to an upper end side of a second anchor member, the second anchor member being provided at the web width direction other end side of the base body and including a lower end side that is fixed to the foundation, and having equivalent tensile strength to the first anchor member, wherein:

the first anchor member upper end side is fixed to the first fixing portion at the opposite side of the flange to the web side, and the second anchor member upper end side is fixed to the second fixing portion at the web side of the flange, and

the base body comprises a first indented portion that is formed to the lower face of the base body at the position of the first anchor member and that opens away from the flange toward an outer periphery of the base body and a second indented portion that is formed to the lower face of the base body at the position of the second anchor member and that opens away from the web toward an outer periphery of the base body,

wherein the base body comprises:

a cutaway portion including a portion along the web that is cut away.

15. A base member comprising:

a base body that has an upper side for joining to a column member integrally provided with a flange at each of two width direction sides of a web, with a center position of the column member offset in the web width direction or in the flange width direction;

a first fixing portion that is fixed to an upper end side of a first anchor member, the first anchor member being provided to one web width direction end side of the base body and including a lower end side that is fixed to a foundation;

a second fixing portion that is fixed to an upper end side of a second anchor member, the second anchor member being provided at the web width direction other end side of the base body and including a lower end side that is fixed to the foundation, and having equivalent tensile strength to the first anchor member, wherein:

the first anchor member upper end side is fixed to the first fixing portion at the opposite side of the flange to the web side, and the second anchor member upper end side is fixed to the second fixing portion at the web side of the flange, and

the base body comprises a first indented portion that is formed to the lower face of the base body at the position of the first anchor member and that opens away from the flange toward an outer periphery of the base body and a

second indented portion that is formed to the lower face of the base body at the position of the second anchor member and that opens away from the web toward an outer periphery of the base body,

wherein the base body comprises:

a first base body having an upper side joined to one of the flanges, and that is fixed to the first anchor member upper end side; and

a second base body having an upper side joined to the other of the flanges, and that is fixed to the second anchor member upper end side, with the second base body provided at a separation from the first base body.

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